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VOL. XIII. NEW YORK, JUNE 22, 1889. No. 25.

Storage Battery Distribution. THAT oft-cited trouble of "uneven pressure" attached to systems of storage battery distribution seems now in a fair way of being successfully overcome. Several methods have recently been described in our columns, and this week we give another by Mr. Pfatischer of Philadelphia, which embraces a number of novel and apparently very valuable features.

Alternate Current Apparatus. MR. MORDEY does not often give public utterance to his opinions on electrical matters, but when the occasion offers, he is sure to present something of interest and almost always of a novel and far reaching character. His late paper before the London Institution of Electrical Engineers is no exception to this rule, and those interested in alternate current machinery will find much to consider in the abstract which we give in this issue.

An Electrical Shot Hoist. WE illustrate on another page one of the newest uses to which the electric motor has been put, namely, hoisting ammunition on board war vessels. We understand that this ingenious application of electricity is highly successful. It must be evident, moreover, to any thoughtful observer, that the use of electric motors instead of small steam engines on board men-of-war has many recommendations on the score of handiness, cleanliness, coolness, economy of space, etc., to say nothing of the preferability of a few circuits of light wire to a complicated system of steam piping all over the ship.

Constant Current Regulation. EVER since the beginning of the construction of arc light machines it seems to have been taken for granted by many that such machines must of necessity be series wound so that the main current might directly influence the field magnets. An interesting departure from the usual type of arc machine regulation is that of Mr. E. P. Clark, described on another page, who has combined with a shunt machine, intended for constant current, an ingenious method of regulation. By employing the counter E. M. F. of a motor, the inventor has been able to avoid the employment of resistance coils as such. Indeed, we note as one of the signs of the times an increasing tendency to the employment of counter E. M. F.'s in one form or another in order to avoid the use of resistances, not only on account of their economy, but also on account of their ready adaptability. The article referred to gives, in addition, it will be noted, further information as to the arc lighting system that Mr. Clark has worked out.

Two Million Visitors a Month. THE attractiveness of the great Exposition at Paris is already established beyond a doubt. A few days ago the theatrical managers of the city were objecting to the practice of opening the Exposition at night, and there now seems to be warrant for their jealousy, though they may not get what they want. During the month of May the Exposition was visited by no fewer than 2,208,045 persons, who paid for their tickets. In 1878, during the same month, and when the exposition opened on the 1st instead of the 6th, there were only 1,269,675 paying visitors, so that the present show is about a million to the good. The sole explanation of this extraordinary difference is to be found in the fact that by means of the electric light the present Exposition is open at night, and that the electrical departments are among the most popular on account of their novelty and brilliancy. We trust that this point will not be lost sight of in the arrangements for the great exhibition in this city in 1892 to celebrate the fourth centenary of the discovery of America by Columbus.

New American Cables. A VERY interesting article appears in our columns this week, by Mr. H. L. Webb, on the subject of the new submarine cable that is to be laid by the Chilian government conecting the Republic with Patagonia and the Straits of Magellan. We trust that this article may have the desired effect of arresting public attention on the opportunities that present themselves for American skill and enterprise in the field of submarine telegraphy. England has just granted a subsidy of $40,000 a year to a company to lay a cable between Halifax and the Bermudas, but as that cable is mainly to subserve strategic purposes, and is short, we need not say much about it. When, however, we look at the fair chance presented in Chili we must confess that we feel loath to see the contract go to England; while as for the new cable which is to be laid from Brazil to this country, we think it would be little short of a national disgrace if the land of Morse and Henry were unable to secure and perform the work. It is true that England has a splendid record in the department of ocean cable laying, but at such a time as this it is pertinent to ask whether America is never to win any of the laurels in this great branch of electrical industry. Our American wires and cables are second to none in the world, yet here we are confronted with the possibility that England will soon be laying not only the Chilian cable and the cable that is so much needed to connect this country with Brazil, but will also be busy on the Pacific cable that is to put San Francisco in communication with the old and new markets of Asia and Australia. Mr. Webb finds an explanation for our utter want of status in the submarine cable industry by pointing to the industrial questions involved, but it may properly be asked whether some of those conditions cannot be successfully encountered, the others being removed.

Electric Railways and Telephony. IN the early days of electric lighting much complaint was heard from those operating telephone exchanges on account of the "interference" produced by electric light lines in proximity to the telephone wires. While these complaints have not entirely died out, their cause has been for the most part removed; and electric light and telephone interests may now be said to be harmonized. But hardly have these complaints been silenced when new ones arise, caused by the growth of electric railways. These latter, in the majority of cases, are operated by the aid of a single feeding wire with a track and ground return. The resulting unbalanced induction between the electric railway and telephone lines has already led to a number of disputes, and to the insistence on the part of the telephone companies that a change in the present method of running the conductors of electric railways should be made so as to prevent induction. Naturally they point to the apparently easy way out of the difficulty, of employing a double overhead conductor system, with lead and return side by side. While this would certainly solve the difficulty, it introduces a number of factors which, at first sight, are not apparent. In the first place, such a system is more liable to accidental short-circuits and more expensive to maintain, while it introduces a number of other difficulties not met with in the single conductor system. Principal among these is the fact that at the intersection of lines the + wire, if carried around the curve parallel with the track, will not intersect the other + wire, as it should, but will meet a — wire, so that any connection between the two is out of the question. This difficulty, though it may not manifest itself on single lines without intersection with others, becomes formidable when the lines are multiplied and frequently intersect, as they do in large cities. Thus some other method seems more desirable, at least until the present difficulty has been overcome. One such method which seems easy of carrying out is that suggested by Dr. Bell in our columns. This method bears some analogy to the one already put into successful practice in Richmond by Mr. McCluer, but adopted in connection with the telephone system instead of the railway. Indeed, the remedy is thus already at hand, so that there ought to be no good reason for insisting upon the erection of a double overhead railway conductor system, where the single will serve.

Efficiency of Electric Traction. IN a recent issue we published an interesting article giving the results of a series of tests which had been made upon the Daft electric road at Asbury Park. The results there obtained, as we pointed out at the time, were of a most encouraging nature and left no room for doubt of the future of the electric railway on the score of economy. Interesting and valuable as that report was, it was unfortunately lacking in electrical details, though giving with considerable minuteness the power required and coal consumed in the operation of the road. In this issue, however, we devote considerable space to another test made on the Sprague electric railway at Lafayette, Ind., and in which Dr. Louis Bell has investigated to the minutest degree every item which could enter into the operation of an electric railway. Coming directly to the question of the efficiency attained on the road, we find that the amount of power actually needed to operate this line is almost exactly 2½ electrical horse-power per car; but, as Dr. Bell shows, the efficiency of conversion from the indicated horse-power at the engine to the electrical horse-power did not average more than 40.7 per cent. throughout the day, though it rose to a maximum of 65 per cent. at one time; and the coal burnt amounted to 7.3 pounds per indicated horse-power per hour, or nearly 16 pounds per electrical horse-power hour. Dr. Bell also shows that the losses on the line indicated an average efficiency of 90 to 95 per cent., and that the motors may be depended upon for an average of 80 per cent. efficiency on the level, and over 70 per cent. on a severe grade. With the dynamo at an efficiency of 90 per cent., and these other efficiencies as given the question naturally suggests itself how such a comparatively large consumption of coal can ensue. The reason becomes clear when it is shown that the principal cause for the low efficiency must not be looked for in any of the electrical apparatus, but is to be sought mainly, first, in a condition inherent in the nature of electric railway work, and, secondly, in the nature of the driving engines. As the curves given by Dr. Bell show, the fluctuations in the power required are enormous and very frequent, and necessarily the engines set for economical work at but one fixed load must be very wasteful under these conditions. As Dr. Bell points out, too, the direction in which to work to increase the efficiency of the electric railway is more in the direction of adapting the steam engine to this particular work than in an increase in electrical efficiency. The problem, as stated by Dr. Bell, is to work an engine on the average at its most economical point of cut-off, while retaining the power of expanding to sudden, though brief, demands for several times the average horse-power. He shows how a heavy fly-wheel would be of great service in smoothing over sudden and heavy draughts of power, and he points out that engines designed for this purpose should have a very wide range of cut-off, so as to allow of that expansion which shall be found to be most economical when the road is in operation. Thus it would appear that any valve gear that cannot cut off beyond half stroke is decidedly objectionable, since it necessitates too large an engine and too great a ratio of expansion. Our engine builders, who have contributed so much to the success of electric lighting, would do well to give this problem their serious attention.

NEW BOOKS.

TERMINOLOGIA ELETTRICA. VOCABOLARIO ITALIANO, FRANCESCO, TEDESCO, INGLESE. By Belloc Luigi. Turin, 1889. 6½ by 9½ inches, 64 pages.

As the name indicates, this is a translating dictionary of electrical terms arranged under four running heads, beginning with the Italian words and followed by the French, German and English translations. The work is a very useful one, but its value would, of course, be increased for English readers if the lists were so arranged that the English words, alphabetically arranged, were followed by the others.

L'ELECTRICITE INDUSTRIELLE ET LA TELEPHONIE EN SUISSE. By Dr. A. Palaz, Lausanne. 1889. Pamphlet, 39 pages.

This is a memoir presented by the author on the proposed law concerning the establishment of electrical lines in Switzerland, and representing the views of those engaged in electrical industries in Switzerland. It discusses principally the provisions of the proposed law which makes it incumbent upon the projectors of electric installations to indemnify all others owning existing lines, especially telephone and telegraph, from any damage due to defective service caused by the effects of the proximity of such wires carrying heavy currents. The pamphlet sets forth the hardship which would accrue by the passage of such a proposed law.

ELECTRICITY AND ITS EMPLOYMENT IN REMOVING SUPERFLUOUS HAIR AND OTHER FACIAL BLEMISHES. By Plym. H. Hayes, A. M., M. D., Chicago, 1889. W. T. Keener, 4½ by 7. 128 pages.

This little book is another contribution to the literature of electrical therapeutics, which is constantly growing. The author seems to have made a thorough study of the histology of the skin and hair, by which he arrives at the proper method to be adopted in the removal of the latter. He describes minutely the apparatus for this purpose, and the mode of operating, embracing the preparation of the skin for the purpose, the precautions to be taken, and the variation in the practice necessary in different individuals.

While the work is principally devoted to the treatment of hair by electrolysis, a chapter is also assigned to the removal of other facial blemishes, and the book closes with a small list of "don'ts," giving the operator information as to the things to avoid in treatment of this nature.

TRAITE THEORIQUE ET PRATIQUE D'ELECTROCHIMIE. Part 3. By Dr. Donato Tommasi, Paris, 1889. E. Barnard & Cie.

We have already noticed this work in our columns, and may add that the third number is fully equal in merit to those which have preceded it.

PHOTOMETRISCHE MESSUNGEN AN BOGENLAMPEN. By Dr. W. Wedding, Berlin, 1889, Leonhard Simion. Pamphlet 15 pages, quarto, with plates.

The author has given the results of an extensive series of experiments on arc lamps in order to ascertain their various illuminating powers, with special reference to the effect of globes, shades and reflectors, and also with varying diameters of carbon. The results are plotted in curves.

Obituary.—Gaston Plante.

It was with deep regret that we recorded last week the news received by cable of the death of Gaston Planté, whose portrait we publish in this issue. M. Planté was born at Orthez, France, on May 22, 1834, so that he was only 55 years old at the time of his death. He was educated at the Conservatoire des Arts et Metiers in Paris, and became a laboratory assistant to M. Ed. Becquerel. After that he entered the service of the well-known house of Christofle et Cie. as a chemist. Here he pursued the investigations which he had begun under Becquerel as to the nature of electrical polarization, and it was these researches that led him up to his great discovery of the lead accumulator which bears his name and has given him his fame. He was at this time, as through all his life, an indefatigable experimenter, and the result of his experiments through a series of years on the discharge of cells was a weakness of sight, which greatly crippled him in later life. From time to time he communicated to the Academy of Sciences and to the scientific papers the results of his work, and in 1879 his communications were issued in a collected form under the title of "Recherches sur l'Electricité." In this volume an immense number of experiments were described, including those which were made with a lead battery of no fewer than 800 elements. This book also included a brief description of his rheostatic machine, a remarkably ingenious appliance, by means of which the potential can be still further raised. *La Nature* speaks of this volume as an imperishable book, which deserves to be regarded as one of the greatest monuments ever raised to the science of electricity, and M. Gaston Tissandier adds that the name of Planté will be handed down to posterity with those of Volta and Ampère as among the immortal founders of the new science. It is remarkable that, although he carried on so many original investigations, Planté never troubled himself to secure patents. He appears to have been fully alive, however, to the possibilities involved in the use of the lead storage battery, as, for example, with the electric light. It is mentioned by the London *Electrician* that two years after the appearance of his great book, namely, in October, 1881, the first actual commercial application of the accumulator took place in connection with train lighting upon the Brighton & South Coast Railway.

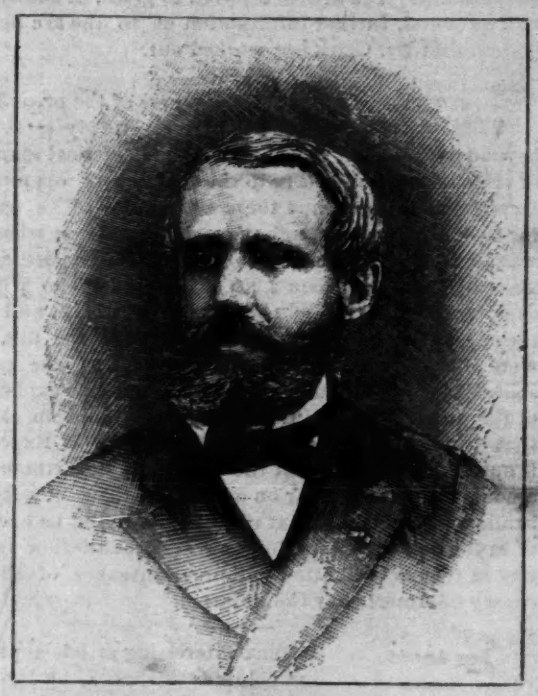
Towards the close of his life, M. Planté devoted himself chiefly to the study of atmospheric electricity, and somewhat more than a year ago he published an interesting volume entitled "Phenomènes Electriques de l'Atmosphère." It is not generally known, however, that in his youth he was greatly addicted to the study of geology and palæontology and that he made some remarkable finds of the remains of extinct birds. M. Planté received the diplome d'honneur at the Paris Exposition in 1881, and he was also made a Chevalier of the Legion of Honor. The Academy of Sciences gave him also the Prix Lucaze and the Society for the Encouragement of National Industries bestowed on him the Medaille d'Ampère. We gather from the notices of his death that he is mourned not only for his zeal and genius as an investigator, but for the amiability and modesty that have always characterized him.

A New Chilian Submarine Cable.

BY HERBERT LAWS WEBB.

Last week a notice appeared in the *Herald*, emanating from the Consulate-General of Chili in this city, stating that the Chilian Government invite proposals for the laying of a submarine cable between Melipulli and Punta Arenas in the Straits of Magellan, with connections at the various ports in the extreme south of Chili.

Submarine cables, and all appertaining thereto, being subjects of peculiar interest to the writer of this article,



GASTON PLANTÉ.

he set forth in quest of more explicit information than the notice above referred to afforded.

The genial Consul-General for Chili in the United States, Mr. Frederick A. Beelen, expressed himself willing to give all the information in his power, and some of the points elicited being of no slight interest, the writer hopes that the first part of this article needs no apology; for the latter portion he does not proffer one.

In April last, the "Cotopaxi," one of the finest vessels in the fleet of the Pacific Steam Navigation Company, was on her voyage out from Liverpool to Valparaiso. The latter port, however, she never reached; and a finer illustration of the well-worn proverb about an ill wind could scarcely be met with; for if, on the 15th of April, the "Cotopaxi" had not collided with another steamer in the Straits of Magellan, and immediately afterwards run upon a sunken rock, and foundered in about eight minutes, the new cable would not have been laid, at any rate for the present; and the cable construction companies might have had to wait a long time for the opportunity which is now afforded to them of securing a fine contract.

It so happened that the "Cotopaxi" carried amongst her passengers quite a number of distinguished Chilians returning home from Europe. All hands were saved, thanks chiefly to the proximity of the shore; but all the baggage and the mails were lost, and owing to the absence of telegraphic communication no news of the disaster, or of the unfortunate plight of the shipwrecked passengers and crew, was received in the centre of Chili until about a fortnight after the occurrence.

The Straits of Magellan are navigated by vessels of all flags, and although the greater part of the shores which inclose the Straits are those of the uncivilized and inhospitable countries of Patagonia and Tierra del Fuego, some of the channels at the western extremity wind their way through Chilian territory and possessions, and Punta Arenas, or Sandy Point as it is generally called in English, which is the only civilized spot in the Straits, is a Chilian settlement. That such a disaster as that which happened to the "Cotopaxi," involving all the possible consequences, which may be left to the reader's imagination, should occur in Chilian waters and no news of the event reach the centre of the Republic until fourteen days after, revealed the existence of a state of affairs the continuance of which was out of the question. The Chilians, therefore, with that energy and promptness of character which causes them to be called, on the other side of the Atlantic, "the English of the Pacific," and on this, "the South American Yankees," at once decided—since the efficient maintenance of an overhead line through Patagonia would be almost impossible—to lay a cable from a point where it will connect with the existing telegraph system of Chili, away down to Punta Arenas.

The cable will be divided into a number of sections. Starting from Melipulli (Puerto Montt), it will go direct to Quincavi (about 42° 20′ S, and 73° 20′ W.), whence following the Chiloé channels and Corcovado Bay it will touch at the new settlement of Palena, on the Isle of Los Leones at the mouth of the river Buta. From Palena to Melinka is the next section; from Melinka, running south through Moraleda Channel and around the peninsula of Taitao, the cable will be laid to Puerto Otway, on the peninsula of Tres Montes, in latitude 46° 50′ S, or some 300 miles distant from the starting point. From this last point the line will cross the Gulf of Las Peñas, and, entering Messier and Smith's Channels, land at Muñoz Gamero, a new settlement which the Chilian government is about to establish in King William's Land, opposite Long Island, in Maine's Channel, about 52° 50′ S. This section will be over 300 miles, and is the longest so far; but the next and last, from Muñoz Gamero to Punta Arenas, the terminating point of the line, will be considerably longer.

The Chilian government is open to receive tenders for the laying of these cables and the complete equipment of the various stations up to Nov. 30 next, on or before which date proposals must reach the Ministry of the Interior at Santiago. The contractors must respond for the proper working of the cables and instruments for a term of one year, to date from the completion of the laying, on the expiry of which term the whole system will be definitely taken over by the Chilian government.

Here is a magnificent opportunity for American enterprise to cut in upon the monopoly of cable making which has so long been enjoyed upon the other side of the Atlantic. The proposed new line, just described, will comprise rather more than a thousand miles of cable and all the apparatus, instruments and stores necessary for the establishment of seven telegraph offices; the contract ought to be worth in the neighborhood of a round million of dollars, rather more than less. It is a standing reproach to American electrical industry and enterprise, that no ocean cable factory exists in the United States, and that no part of the immense amount of good work that has been done in submarine cable engineering during the last thirty years, has been carried out by Americans.

It is urged that the high price of iron wire, which constitutes one of the most important, perhaps *the* most important item in the manufacture of a long cable, and the dearness of labor on this side, preclude the possibility of an American cable factory competing with the English on equal terms. But these ought not to be insurmountable obstacles. An arrangement could doubtless be come to with the government by which the duty on iron wire intended for cable manufacture should be remitted, or the amount returned on the shipment of the completed cable, and its departure for that part of the world where it is to be submerged. As regards the labor question: if it is possible to manufacture in this country engines and machinery of all kinds, electrical instruments and telephone material of every description, and send them to England and all parts of Europe, to compete, on their own ground, with similar goods made in Great Britain and other European countries, why should it be impossible to do the same with submarine cables?

To start cable works on the scale that would be necessary, and to properly equip a cable steamer, would involve the employment of a considerable amount of capital, which, like iron wire and labor, is also dear on this side. But if the capital for tunnels, railways, and other important engineering works, comes largely from beyond the seas, why should not the same be done for a cable factory? It would be truly American to start an industry to break in upon a great British monopoly, with the aid of British capital.

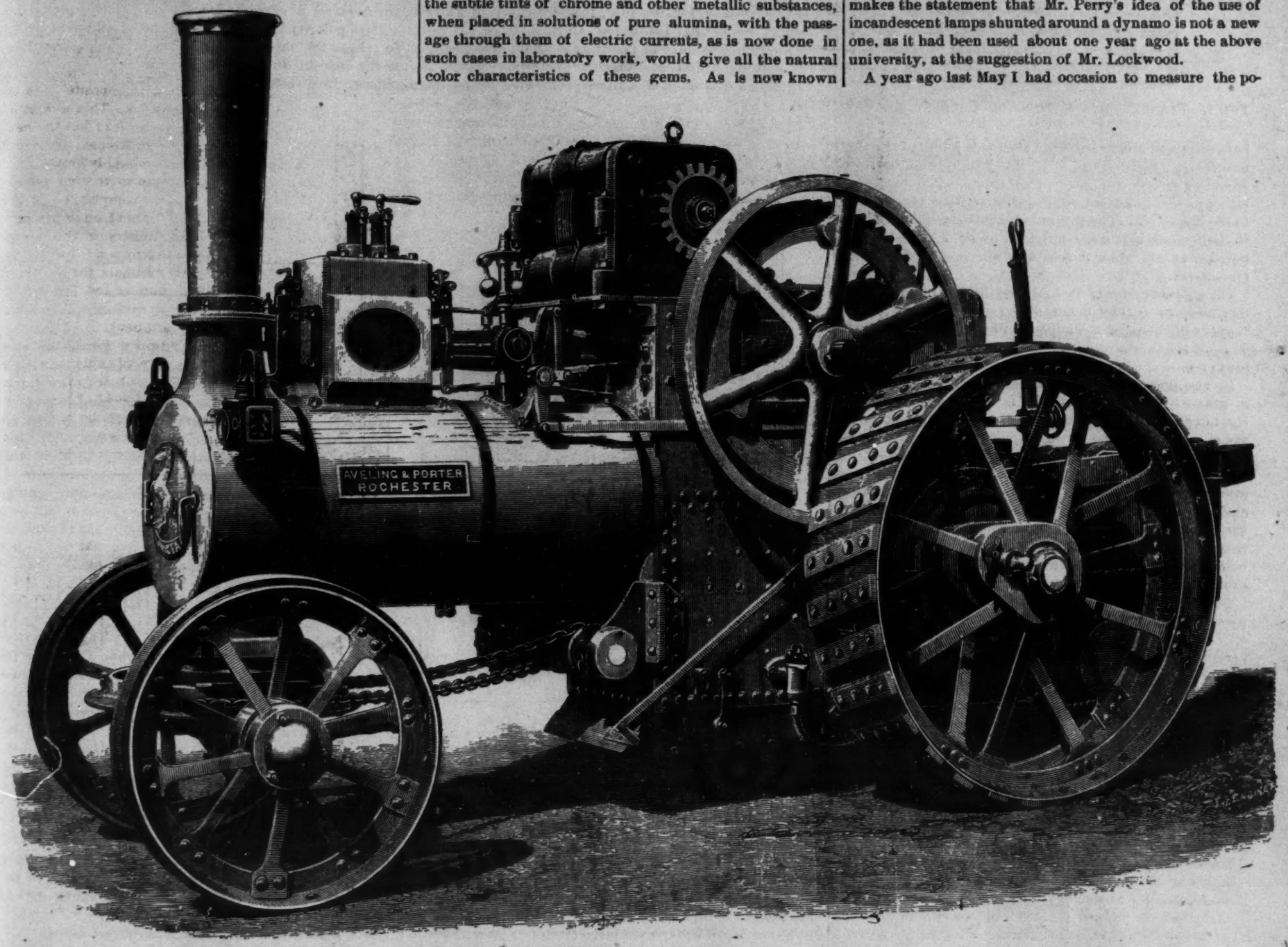
The new Chilian line, upon which this article treats with perhaps undue prolixity, is not the only piece of cable work in prospect, as the Brazilian government is calling for proposals to lay a cable from that country to the United States, and this will be a contract of much more importance than the former, both on account of the greater length of line, and the scene of operations being much nearer home.

Glass Tube Conduits.

Experiments are being made on the Continent with a novel form of conduit for underground mains. The conduit consists of a glass tube, protected by a thin coating of specially prepared cement, and inclosed in a cast-iron pipe, the iron being run on hot. Bare conductors can then be used, and it is asserted that not only is the insulation very high but that the conduit is cheap and perfectly airtight. How the difference between the coefficient of expansion of glass and iron is accounted for, says the London *Electrician*, we are at a loss to understand.

An Electric Light Traction Engine at the Paris Exposition.

It cannot yet be said that all the advantages to be obtained from the use of electricity in agricultural operations are fully appreciated, but there are many indications of development in this direction. We illustrate on this page a very interesting piece of apparatus for agricultural work which is now exhibited at the Paris Centennial Exposition by Aveling & Porter, of Rochester, England. It is a traction engine which has been built with a special view to road and field work. As will be seen, the dynamo for generating the current is a compact and neat machine substantially built and firmly mounted above the engine. The dynamo is driven by gearing, one of the wheels being fitted with teeth made of vulcanized fibre. As will be readily seen, too, such a traction engine and plant can readily be taken from point to point on the same farm, and from one locality to another, thus materially facilitating farm operations at critical seasons of the year. It seems to us that numerous opportunities present themselves in this country for the utilization of such apparatus, and we are a little surprised that so far, to our knowledge at least, none have been built.



ELECTRIC LIGHTING TRACTION ENGINE, PARIS EXPOSITION.

Electrical Agency in Gem Formations.

For half a century it has been a favorite theory with many eminent scientists that electrical action had much to do with the crystallization and color properties in gems. In the papers of the late eminent scholar, Mr. H. C. Sorby, of Sheffield, Eng., the influence of ozone in the determination of color matter, in vegetation and cloud effects, and of electrical currents in mineral and metal formation, were discussed with great intelligence and earnestness. In the department of color, Mr. Sorby had no scientific superior, and but one or two peers. The search for gems in the secondary formations, which until a recent date were considered as their original matrix, was always accompanied with a vague sort of faith that sunlight had much to do with brilliancy of color in the formation of the gems; and so that beneath the surface, nothing but opaque or colorless stones would be found. The recent coming into British possession of the ruby mines of Burmah, has renewed the old-time discussion in England as to the peculiarities of gem formations. Amid an excitement at the banking house of the Rothschilds, in the struggles for investments in gem localities, that has never known a parallel in the placing of securities, there has come the statement from leading authorities there, in such matters, that the finder of ruby gems, in a primitive rock formation, as distinguished from the wash of the streams which have been hitherto considered as their proper mining ground, should be crowned "King of Rubies."

Apropos to this discussion, it may be said that that title, if given to any one, will by right remain this side of the water. The true oriental sapphire of blue, green, red and other tints, was found in 1872 in the Corundum mine of North Carolina, known as the Jenks Mine, in a mass of serpentine trap, 50 feet below the surface. The evidence of peculiar igneous action in this district, was commented upon many years ago by the eminent authority we have referred to, Mr. Sorby, by Dr. J. Lawrence Smith and others, to whom specimens from the locality were submitted, and which by them were subjected to the most critical chemical and microscopic examination.

It was determined by Mr. Sorby that a distribution of the subtle tints of chrome and other metallic substances, when placed in solutions of pure alumina, with the passage through them of electric currents, as is now done in such cases in laboratory work, would give all the natural color characteristics of these gems. As is now known from the experience at the Jenks mine, deep down in the rocks, the corundum gems may be found in all their purity and brilliancy of color. Therefore, it seems valid ground for the conviction, that electricity was operating with mysterious energy in the ages of the past as an artist in color as well as force.

All the constituent elements in color formation that electricity would need for its palette are found in the location we have spoken of in the South; and by comparison, they are identical with the débris in Ceylon and Burmah.

If the crown is to be worn by any one, let it be placed upon the head of Col. C. W. Jenks, of the Sprague Electric Motor Co., who twenty years ago first located all the Corundum gems in a solid rock matrix in his mine; and who at home,* and also among the scientific authorities of Europe, † publicly expressed his conviction that electricity had a most active agency in the coloring of the brilliant gems that, first in the history of such mining, he had uncovered far beneath the surface, in the primitive rock formations of the Allegheny range in North Carolina.

* In an address before the Society of Arts, at the Mass. Inst. of Technology, Boston, March, 1876.

† In a paper read by him before the Royal Geological Society of England, Duke of Argyll presiding, January, 1874.

Electrolytic Assay of Copper.

In estimating copper electrolytically, Herr F. Rüdorff says: "It is advantageous to acidify the solution with nitric acid; but when chlorides are present considerable time is taken up in evaporating the solution with sulphuric acid. He found that when an ammoniacal copper solution is electrolized the metal separates in a spongy condition, but that if two or three grams of ammonia or potassium nitrate be added, and then about 10 cc. of ammonia for every 100 cc. of the solution containing 0.1 — 0.3 grams of metal, the latter separates in excellent condition, even when the strength of current employed varies between considerable limits. The operation is at an end when the solution has become colorless."

The Perry Method of Measuring High Potentials.

To the Editor of The Electrical World:

SIR: In an article of June 8th, on measuring potential, Prof. H. S. Carhart, of Ann Arbor University, Michigan, makes the statement that Mr. Perry's idea of the use of incandescent lamps shunted around a dynamo is not a new one, as it had been used about one year ago at the above university, at the suggestion of Mr. Lockwood.

A year ago last May I had occasion to measure the potential of a motor supposed to be in the neighborhood of 400 volts, and having only a voltmeter of a capacity of 120 volts, was at a loss how to do it without incurring much expense. Mr. Perry, of the Baxter Motor Company, suggested that we shunt the motor with incandescent lamps, and measure each lamp, adding the totals, which would be near enough the actual test. I was so favorably impressed with this mode, that I at once tried it as a method of taking the potential of the dynamos, and made a test board for this purpose containing 30 100-volt Sawyer-Man incandescent lamps, in series, and arranged so as to be shunted around any one of the dynamos direct at the switch-boards. I had had this in our main station for a short while when Mr. Lockwood visited the station, and I showed it to him, and explained its use, also explaining that I had found it unnecessary to take a separate reading of each lamp, but that the reading of one section, multiplied by the total series, gave the result as closely as could be got by going over the whole lot, on account of the liability of a change in current taking place while making the test, which might change the reading.

It is in justice to Mr. Perry and myself that I write this, as I do believe that the idea was new and original in regard to both of us.

G. E. FISH,
Electrician, Chicago Arc Light and Power Co.

Pfannkuche's New Method of Current Measurement.

Mr. Gustav Pfannkuche, of Cleveland, O., whose previous electrical work is already known to our readers, has recently succeeded in devising a new instrument for measuring current and potential which possesses some highly-original features. In this instrument Mr. Pfannkuche employs the well-known thermopile, which is acted upon by the heat generated by the current in the main circuit; and the current thus generated in the thermopile is measured in a suitable galvanometer.

The instrument is shown in the accompanying illustrations, Figs. 1 and 2, in side elevation and section respectively. The bars *a a'* are composed of German silver, and

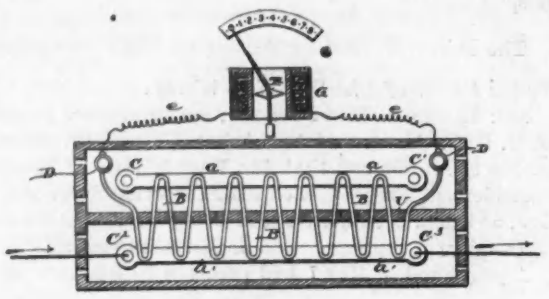


FIG. 1.—PFANNKUCHE'S METHOD OF CURRENT MEASUREMENT.

between them are inserted the alternate joints of the thermo-pile or thermo-spiral *B B*, the joints being insulated from the bars by thin plates *P*, of mica. The bars, insulating plates, and thermo-spiral are secured together and to the base board *H* by means of insulated bolts *O*. The German silver bars *a* are provided at their ends with the terminals *C C'*, while the bars *a'* are provided with end terminals C^2 C^3.

The galvanometer *G* is included in the circuit of the thermo-spiral *B B* by means of the conductors *e e'*, which connect the helix of the galvanometer with the terminals *D D'* of the thermo spiral. The partition *N* prevents the heat of the bar *a'* from being transmitted to the bar *a*.

In the operation of the apparatus the current to be measured, or a portion of it, is first converted into a thermo-electric current, the thermo-pile standing in the same relation to the main circuit as a converter, the primary coil of the thermo-pile being represented by the heating bar or device through which the current to be measured is passed. As is well known, variations of heat applied to the alternate joints of a thermo-pile produce variations in the current generated by the thermo-pile, so that the variations of currents to be measured are indicated by the variations in the strength of the thermo-electric current.

The apparatus is constructed so that when no current is passing through the heating wire or rod the two sets of alternating joints of the pile are of exactly the same temperature, and hence when no current is passing through the device the galvanometer points to zero.

Upon the passage of current through the bar *a'*, to the terminals of which are connected the ends of the circuit in which the current is to be measured, the bar will commence to heat, and the heat will increase as the current to be measured increases in quantity, the temperature of the bar *a'* varying with the varying quantity of current passing through it, and as the difference of temperature of the

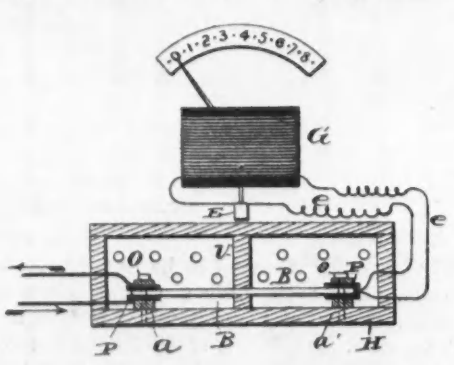


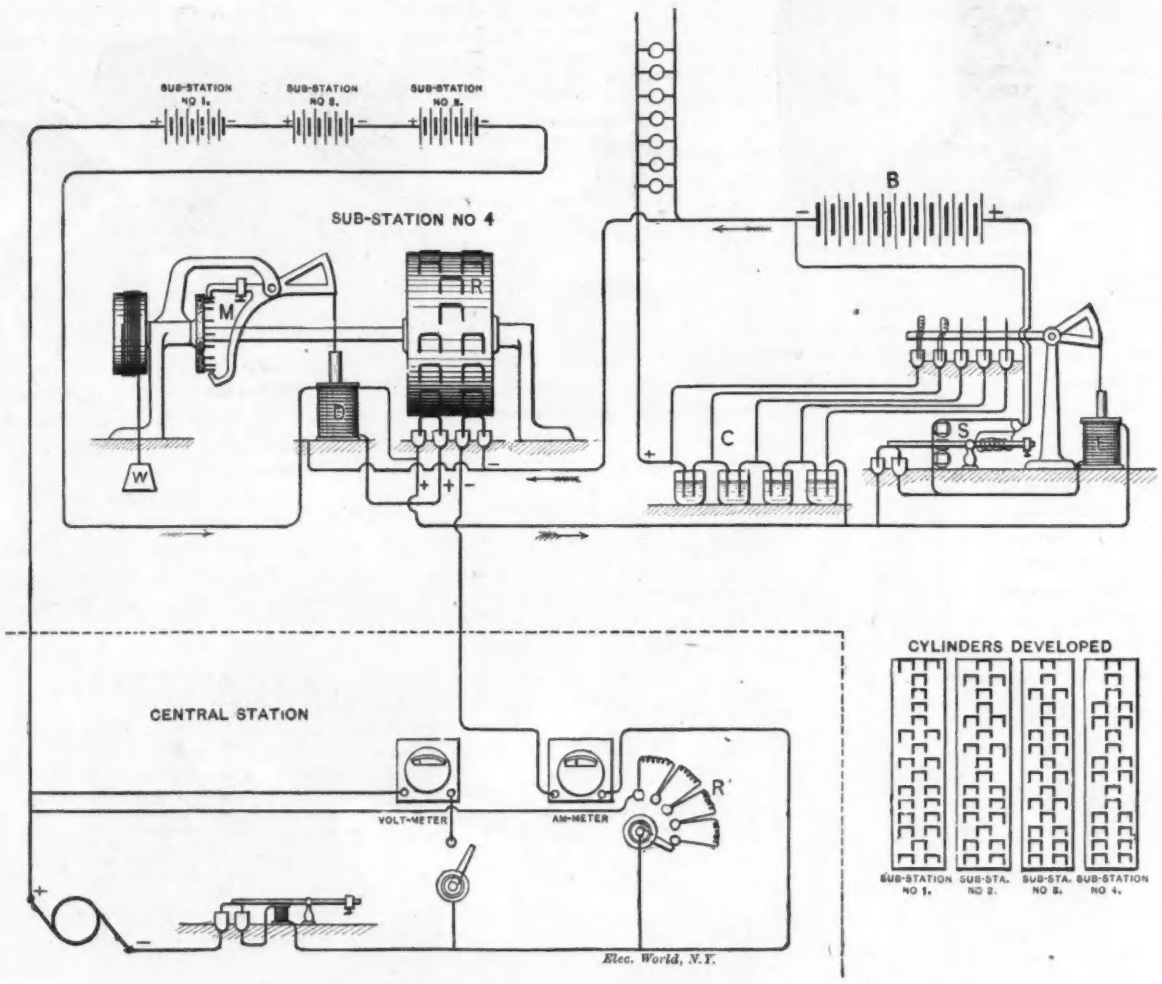
FIG. 2.—PFANNKUCHE'S METHOD OF CURRENT MEASUREMENT.

bars *a a'* varies, such variations will be indicated by the deflections of the galvanometer, so that the latter operates to indicate and serve as a measure of the current passing through the bar *a'*. The bars *a a'* are made of the same material, and are uniform in size and shape and in every way, so that the temperature of the alternate joints of the thermo-pile when no current is passing through the instrument will always be the same, regardless of what the temperature in the containing box or room, in which the apparatus is placed, may be. In view of the well-known fact that the difference of potential of a thermo-pile depends for given material and construction only on the difference of temperature of its alternate joints, it follows that the instrument's readings must always be correct, no matter whether the outside temperature be high or low, and it is by the varying strengths of the the thermo-electric current, which act upon and are recorded by the galvanometer, that the strength of the current in a circuit can thus be measured without employing the current itself as the direct agency for actuating the device.

The Pfatischer System of Electrical Distribution by Secondary Batteries.

That there are many advantages in the storage battery system for the distribution of electric currents over extended districts for lighting and other purposes is unquestioned, but in the practical carrying out of this system several very serious obstacles to its success have been encountered, that have not only been a cause of considerable trouble, but have also in a great measure been responsible for the comparatively limited number of such storage battery central station plants now in operation. Hitherto it has been necessary for a man to go around the entire circuit, no matter how extended, at different times during the day and night, to cut batteries in or out of the charging circuit, and even by this means, in extended districts, it has been found difficult to maintain the batteries with that degree of exactness which they require. Again, the potential of a battery rises when current is flowing into it and the rise is very nearly proportional to the charge it is receiving.

Let us assume, for instance, that a battery of 52 cells (suitable for 100 volt lamps) has an E. M. F. of 104 volts. The internal resistance in charging is 0.0055 ohm per cell, thus making a total resistance of battery of 0.28 ohm. Supposing a current of 40 ampères is flowing which must raise the E. M. F. to 116 volts, the result of this high voltage is great destruction and variation in candle power of lamps. To overcome this it has been customary to send a man around to the different sub-stations and have him cut out a number of cells on the lamp circuit or insert a resistance in the same to accommodate the varying potentials. It is easy to conceive that this entails considerable work with the load constantly changing at a number of sub-stations, to say nothing about the inconvenience and the cost of labor. It has been found very difficult to supply anything like a constant E. M. F. to the lamp circuits with this method.



THE PFATISCHER SYSTEM OF STORAGE BATTERY DISTRIBUTION.

Both these objections have recently been obviated by simple apparatus designed by Mr. M. Pfatischer, of Philadelphia.

Taking for granted that a system of this kind is faultlessly wired, Mr. Pfatischer holds that the following points are essential to its success:

1. Good cells.
2. Automatic regulation of potential in lamp circuits with simple devices requiring little or no adjustment and not liable to derangement.
3. Means which enable the engineer at the central station to cut in or out any particular battery on, and by means of, the charging wire.
4. Means at the central station for ascertaining the E. M. F. of any battery in the system.

As to the first point it may be said that at the present time secondary batteries leave very little to be desired when properly cared for. Buckling has been entirely overcome, and short circuiting between the plates is no longer possible with the cells of recent construction.

The automatic apparatus for maintaining a constant potential on the lamp circuit is shown in the accompanying diagram. It consists of a properly proportioned sectional resistance, or counter E. M. F., in the form of cells *C*, placed in one of the leads of the lamp circuit, operated by an electro-magnet or solenoid *E*, and a polarized electro-magnetic switch *S*. When the current is flowing from the battery *B* it is shunted around the electro-magnet and counter E. M. F. cells *C*, but when current is flowing into the battery the polarized switch is reversed and the electro-magnet cuts into the lamp circuit a resistance or counter E. M. F., proportioned so as to compensate for such variation in potential as may occur.

The control of the batteries of outlying stations is effected by means of a rotating cylinder *R*, at each battery, on which are placed a series of metallic loops which make contact through mercury cups and are so arranged that by rotating the drums the charging current is either sent through the battery or shunted around it on the line. These metallic loops bear a different relation to each other at every sub-station.

The cylinders are rotated by means of a step by step movement *M*, actuated by a differentially-wound solenoid *D* and a weight *W*. Through the fine wire circuit around the solenoid a current flows continuously, producing a certain polarity in the core, but not of sufficient strength to release the ratchet wheel. The dynamo current flows in the opposite direction to the current in the fine wire circuit, thus neutralizing the effect produced by the shunt. But if the dynamo current is stopped, and a current from the batteries or battery is allowed to flow backward in the charging wire, it will aid the shunt and cause the cylinders to advance one step.

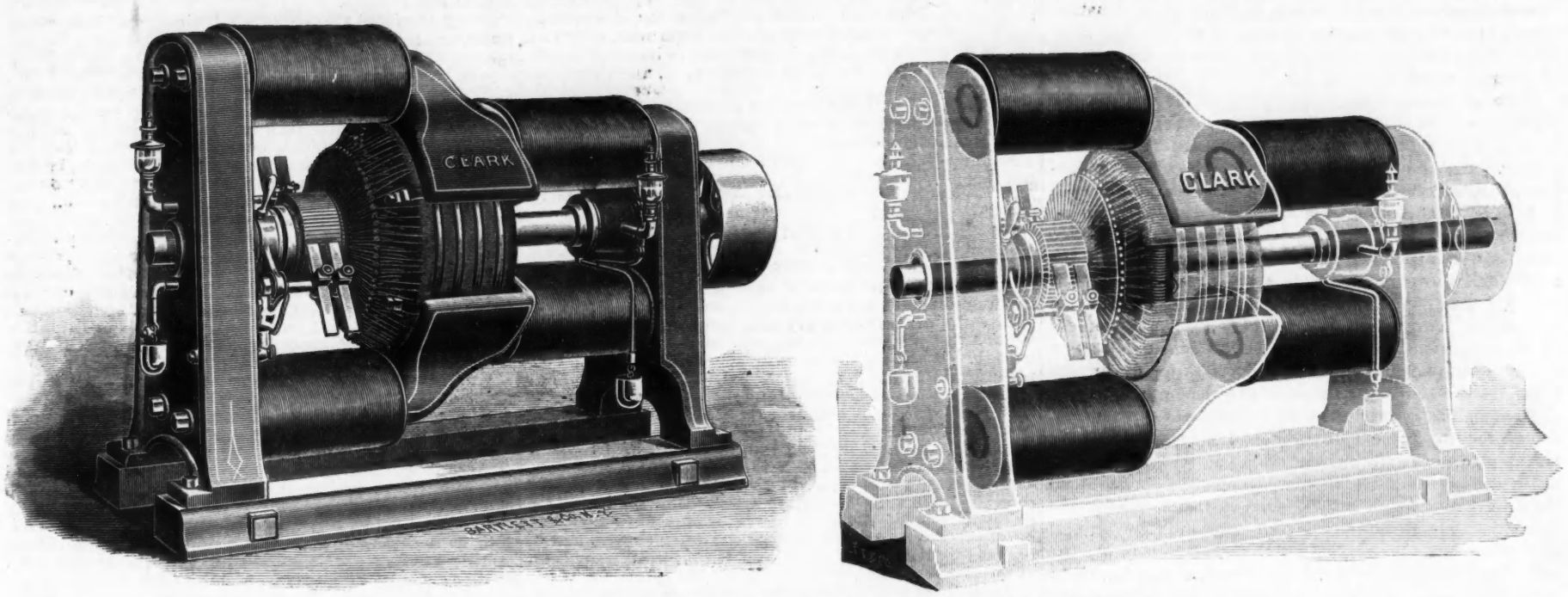
Each pulsation of back flow is regulated and effected at the central station by closing the charging wire through proper resistance *R'*, which causes the cylinder to advance one step. The same results are obtained, therefore, as if separate wires were run to each sub-station for the purpose specified.

It can easily be seen that the apparatus described enables the engineer at the central station to read the E. M. F. of any of the batteries at the sub stations, and thus entirely obviates the necessity of constant inspection.

A Cable from the United States to Brazil.

For some time there has been talk of a cable from Brazil to the United States, and a year or two ago the Pedro Segundo Company was formed in this country, under what is known as the Cummins concession, to carry out such an enterprise. The Cummins concession has now expired, so that the Pedro Segundo Company may be regarded as having lost its *raison d'être*, but the project is not abandoned. On the contrary, it is likely that it will soon be put through successfully. The Brazilian government has published at Rio de Janeiro, under date of April 16, the terms under which it will grant a concession. It would appear that sealed proposals may be submitted up to Oct. 30, 1889, at the Bureau of Public Works, Rio de Janeiro, or at the Brazilian Legations at London, Paris and Washington, accompanied by a deposit of $10.000 as guarantee. The cable is to be laid from the town of Vizeu, in the province of Para, to the

shore of the United States, and any connection on this cable, for European service, is expressly prohibited. The Brazilian government agrees to give the concessionnaire the exclusive right not only to land his cable but to connect with the Imperial land lines and forward messages over them. The connections for this purpose will belong to the government and be built by it. The first of the cables—there may be one or more—is to be laid within a year from the date of the contract, which will lapse in case of an interruption of service, not caused by accident, for any period exceeding six months. The tariff is not to be higher than that to Europe, no discrimination in rates will be allowed, and if the dividends exceed ten per cent. corresponding reductions in the tariff may be called for. On receipt of the concession, the contracting party is to increase his guarantee to the sum of $50,000. The manufacture of the cable is to be carried on in a manner satisfactory to the Government. The person obtaining the concession may assign it to a company formed for the work. Further information can be obtained from the Brazilian Legation at Washington.



FIGS. 1 AND 2.—THE CLARK ARC DYNAMO, SHOWING INTERIOR FIELD.

The New Clark System of Electric Lighting.

Some time ago we described in these columns the system of the Clark Electric Company, the distinguishing feature of which consisted in the peculiar construction of the dynamo with pole pieces exposed to the interior of the armature ring and with interior re-enforcing magnets.

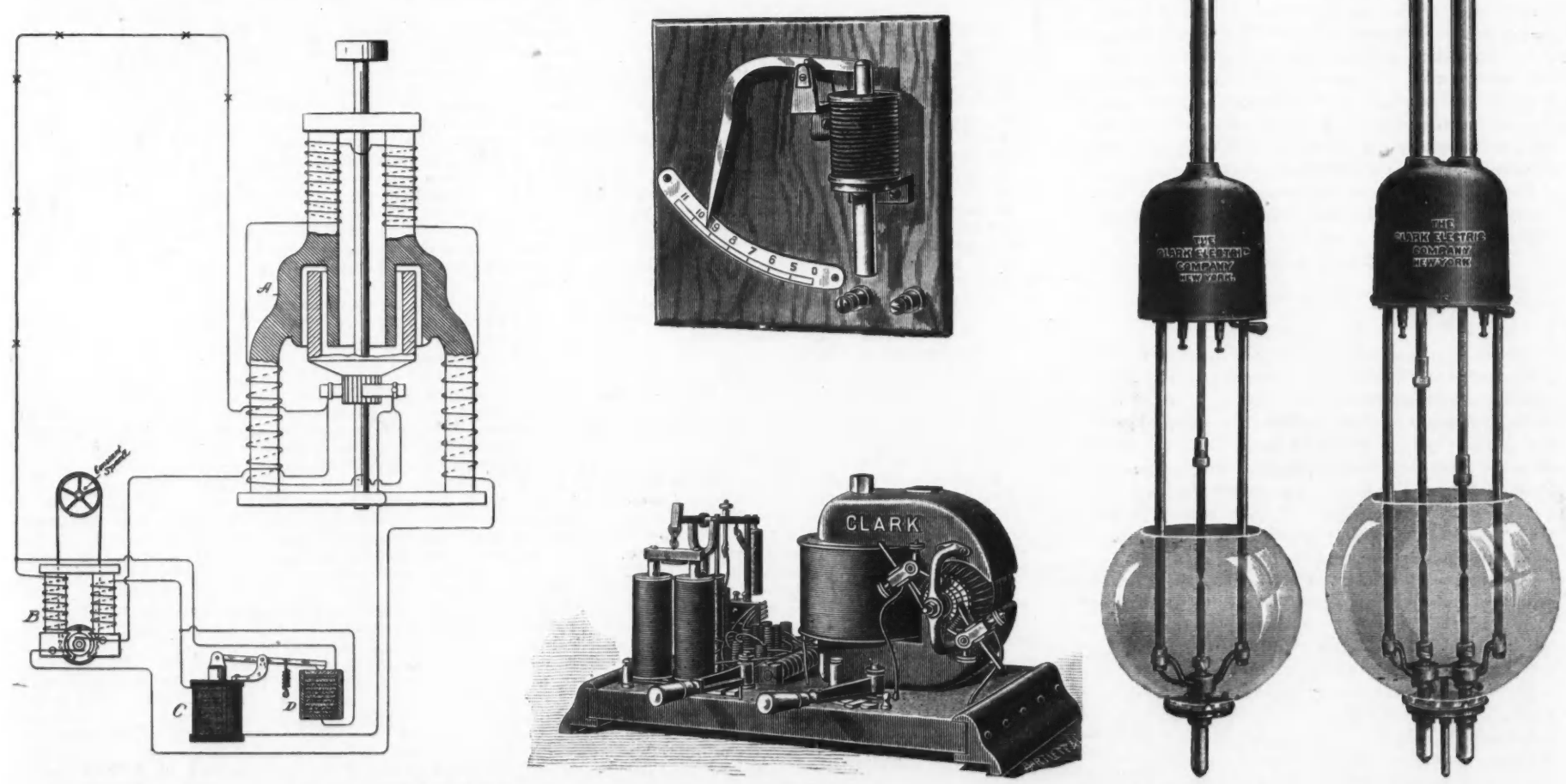
The system has recently been considerably improved by Mr. E. P. Clark, the electrician of the company, who has introduced a number of modifications in the original apparatus.

The dynamo, as now constructed and shown in Fig. 1, presents some points of interest in details, such as an unusually long and deep commutator, provided with two independent brushes on each side, either one of which is well able to carry the current; thus allowing the brushes to be changed or turned over while the machine is in operation. The shaft, as will be seen, is very strong, being made of cast steel, and runs in gun metal bearings. The armature cores are made of iron wire, insulated with cotton and wound into the proper form. A better division of the iron is thus obtained than by making the cores of sheet iron rings with insulating material between them; but as the core in the usual method of this construction is laminated in both directions instead of only in one, its magnetic resistance is somewhat increased, which is a serious objection to such cores. In these machines, however, the pole pieces of the field magnets are presented not only to the outside of the armature, but to its inner surface as well, as shown in Fig. 2, and by this means an enormous increase of the polar surface is secured, which is claimed to render the wire cores of these machines more effective than a sheet iron core. The machines are shunt wound. They are calculated throughout to secure the highest possible efficiency, and it is stated that after a long run no portion of the machine is ever found uncomfortably warm to the hand.

One of the distinguishing features of the new Clark system is the method of regulation of the dynamo to maintain constant current, which is effected by the employment of a most novel and ingenious principle.

As stated above, the dynamo is shunt wound, and instead of using an adjustable rheostat in the field magnet circuit, as is the usual practice with machines of this class, in the Clark dynamo the exciting current is varied by means of an adjustable counter electromotive force produced by the small auxiliary machine shown in Fig 3. The manner in which this is accomplished will be understood from the diagram Fig. 4.

The armature of the small auxiliary machine *B* is included by means of its brushes and commutator in the field magnet circuit of the dynamo *A*. The armature is of the Siemens type, but wound with a large number of turns of wire; as the current passing through it is very small (in the arc machines never exceeding $\frac{4}{10}$ of an ampère) the wire of this armature is quite small. The armature revolves in the field, as shown, and when the current passes it becomes a motor, and, of course, sets up a counter electromotive force, the amount of which will depend upon the velocity of revolution of the armature, and the strength of the field in which it revolves. The speed of the armature is limited to a certain number of revolutions per minute, by means of a small belt running from the pulley on the armature shaft to another one on the dynamo, or a line shaft or some other revolving shaft whose speed is constant. As the speed of the armature cannot change, its counter E. M. F. can only change by reason of a change in the magnetic strength of its field magnets. The main current on its way to the line passes through the coils of the regulator field magnets, and thus supplies the field in which the regulator armature revolves. If from any cause the main current should increase in



FIGS. 3, 4, 5, 6 AND 7.—CLARK AUTOMATIC REGULATOR, AMMETER, SINGLE AND DOUBLE LAMPS, AND DIAGRAM OF CIRCUITS.

strength, it will at once cause an increase in the power of the field of the regulator, and an increase in the counter E. M. F. of its armature, which, being opposed to the exciting current of the dynamo field, reduces that current at once, and with it the strength of the magnetic field of the dynamo. This at once reduces the generating power of the dynamo and brings the current back once more to its standard strength. If the strength of the main current should decrease for any reason, the opposite action will take place. The regulator field magnet decreases in strength, the counter E. M. F. of its armature diminishing, and the current through it and the field magnets of the dynamo increasing; thus restoring the strength of the main current.

There is another piece of apparatus included in the regulator also shown in Fig 3. It consists of a solenoid, located in the main circuit, whose armature is attached to a lever. The other end of this lever carries a sliding contact piece, which slides over a number of sections or contacts of copper. A number of small spirals of German silver wire are connected to these contacts, and arranged so as to form an adjustable shunt for the field coil of the regulator, whose resistance in the 30-light apparatus is only $\frac{15}{100}$ of an ohm. By means of this arrangement, when the main current falls a trifle, the resistance of the German silver coils is diminished, and a greater portion of the main current is shunted through them, instead of passing through the field magnet coils. This, of course, causes a further reduction of the magnetism of the regulator field magnets, the reverse action taking place when the current rises. It will be seen by this description that the regulating power depends upon the disturbance which is to be corrected, and the greater the disturbance the greater is the regulating power; and as it is not necessary that anything should move, the regulating influence can be exercised to a great extent instantaneously, while the entire power of the regulator can be exerted in the fraction of a second that is required for the lever of the solenoid armature to move.

It is stated that the 30 light regulator exerts a counter E. M. F. under extreme variations of the main current, ranging from three or four to 700 volts, which is enough to control the dynamo under the most violent changes of load, and as there is no train of gears or ratchet movements to be put in motion, the regulation is accomplished almost instantaneously.

The Clark arc lamps, both single and double, are shown in the engravings Figs. 5 and 6. They are storm proof, and do not require any hoods or other devices to protect them. The binding posts are on the under side of the case, and arranged so as not to become short-circuited by sleet or snow. The switch is also on the under side of the case where it can be seen by the person operating it. These lamps have been exposed to the worst storms of the past winter, and although at times completely covered with ice and snow, they have never failed to start when the current was turned on. The movement is a powerful one, and moving parts are heavy in proportion, the carbon-holding rod weighing alone 16 ounces.

The simple form of ammeter, shown in Fig. 7, is placed in each circuit as an indicator of the proper working of the machine.

Queries on Selenium.

To the Editor of The Electrical World:

SIR: In your issue of Feb. 16, 1889, there was published a short item entitled "The Electromotive Force of Selenium," in which reference was made to a method of preparing selenium so as to render it capable of generating "E. M. F." by the action of light. Will you kindly inform me where selenium, *thus prepared*, can be obtained? I am anxious to know and have made various efforts to get it, but without success. If you cannot inform me, will you give me the address of S. Kalischer, or others named in the item referred to.

One would infer from said item that the phenomenon described was first discovered in 1887; but Deschanel (1883) mentions the discovery as having been made by Mr. Willoughby Smith. According to this authority, "a strong instantaneous effect is observed at the moment when light first falls upon the substance, and the effect gradually increases for some time if the exposure to light is continued." Prof. G. W. Adams is also credited with certain interesting experiments in connection with this curious substance. D. H. FLETCHER.

CHICAGO, Ill.

[We shall be glad to publish the address of any one now making selenium cells.—EDS. E. W.]

Lights from Primary Batteries.

To the Editor of The Electrical World:

SIR: Will you please inform me through your valuable paper whether any electric light can be produced by a battery; I mean a small light? Please mention what kind of battery can be used. The simpler the better.

ALBANY, N. Y. H. J. B.

ANSWER.—Electric lights can be run from primary batteries. For a small light some form of the Bunsen battery may be used, such as the Fuller. If light is wanted for a short time only and at intervals, the Grenet cell will answer very well.—EDS. E. W.

Problems in Electric Traction.

BY DR. LOUIS BELL, PURDUE UNIVERSITY.

The preliminary stage of electric tramways is to-day quite gone by. While three years ago such an application of electricity was regarded very dubiously, that doubt is now displaced by the certainty that the electric road is a success and has come to stay.

The live question to-day does not involve the chances of the electric road but the chances of its competitors. There are now something like fifty electric roads in regular daily operation in the United States, covering about two hundred miles of track, employing all sorts of systems, working under all manner of adverse conditions, climbing grades of pitch equivalent to four and five hundred feet to the mile, taking curves of all possible radii, and there has been with all this no report of failure anywhere.

On very many of these roads electricity has replaced horses, and nearly every week brings reports of similar substitutions elsewhere.

No inroads have as yet been made on the cable systems, but it is an open question whether they can hold their own, even in the favorable localities where they are already established.

No one need ask, in face of these facts, whether electric traction is practicable or successful, but rather such questions as these: How efficient is it? What is its first cost, compared with horse or cable traction? How do its running expenses and repairs compare with these? What grades and curves can safely and economically be taken? What accidents is it liable to, and how can they be prevented? What are the conditions of efficient and economical running?

It was for the purpose of attempting to answer some of these vital questions that the present investigation has been carried on.

To obtain thoroughly practical results applicable to the everyday working of an electric tramway I have not concerned myself with theoretical motor tests and curves such as are detailed in Mr. Sprague's now famous paper on his Richmond road, but have confined myself quite closely to actual car tests of power and efficiency, and to the evidence of the ammeter and the indicator diagram at the power station. I do not at all underrate the value and importance of the above mentioned theoretical curves, but that ground was so thoroughly covered in the paper in question that a repetition is needless. Furthermore, the man who contemplates putting his money into an electric road does not particularly care about the characteristic of the motor used, but he does want to know how much power must be developed on his cars, how much coal he must burn at the power station to obtain it, what efficiency he may expect from the system, what are its weak points, and how they may be strengthened.

Through the kindness of Mr. Hawter, superintendent of the La Fayette (Ind.) Street Railway, every facility has been afforded me for making a thorough and detailed test of the road, and such of the results as may properly be published are recorded in this paper, only such details as directly concern the private business of the company being omitted.

Before taking up or discussing these experimental results, I purpose considering the general conditions under which electric roads must operate, the general difficulties to be met and the relations of this method of rapid transit to those with which it has to compete. There are many requirements for street railway work which are not met with in any other kind of traction. For most of these the electric motor is admirably adapted, while for a few it is not. Consider then the conditions to be met in street railway work and the properties that a motor of any kind must have to be thoroughly suited to these conditions.

1. To meet public convenience a tramway line must in nearly every case run through the most frequented business streets of a town, and outside the business portion must pass through, or very near to, the thickly populated residence streets and on to the larger suburbs. It, therefore, is generally not at liberty to pick out a route of the easiest grades and curves, but must be able to surmount quite severe grades readily, and take without much danger of derailment any curves that the streets require, sometimes of radii barely above twenty feet.

2. It should be thoroughly reliable, *i. e.*, track and motor system should be so constructed that the system will be of very little danger, first, of a complete breakdown, interrupting travel throughout the line, and, second, of local accidents sufficient to pile up cars at any particular point.

3. It should have a considerable flexibility in the matter of speed. In any line where the cars run on anything like a fixed schedule, as will always be the case in anything except the very largest lines, they must be able to make up lost time within reasonable limits in case of a trifling accident or unusually frequent stops. For this reason the maximum speed should be considerable.

4. It must be able to stop and start quickly and easily. Running through crowded streets and liable at any moment to find its tracks blocked, the only security against serious and frequent accident is in the ability to stop quickly, even when running at full speed. Easy and quick starting too is quite necessary, since so much of the running time is taken up in just this way.

5. Track and motor system should be of such a kind as will cause the minimum amount of obstruction to the streets and annoyance to the traveling public. For this reason the rails are very low and unobtrusive, consequently somewhat less secure. Since most of the traffic is and will continue to be carried on by means of horses, any system that renders it difficult or dangerous to drive in the same street is open to objection.

6. The motor system should be tolerably silent, and of such a kind as not to prove a nuisance to the streets through which it passes. This condition and the last practically preclude the use of anything like the usual steam motors, except in the rare cases where the line can be carried through unfrequented streets.

7. It must be so arranged as to meet readily the demands of an unusual crowd at some one point. It frequently happens that most of the cars of a system must be started under nearly full load within a few minutes. This is specially true of lines connecting with suburbs, where the traffic is likely to be very uneven.

With all this, any tramway system must be tolerably economical in operation, and its first cost must not be prohibitive.

These conditions cover most of the points in street railway work, although in special cases they may be considerably modified. To meet these requirements all sorts of devices have been brought out. Of course, the use of horses is the principal method even now. Next in order come those motor systems which are modifications of the ordinary locomotive; then the cable traction systems, and finally the various electric systems. We have no concern here with the second class of motors above mentioned; they occasionally serve a useful purpose, but for every day use in crowded streets they have been adjudged by common consent a nuisance.

Taking, then, the three systems in extensive use, let us see wherein they do, or do not fulfill, the above conditions, specially seeking out the weak points and difficulties of the electric systems.

So far as grades are concerned, the cable system easily takes first rank, for its power of hill climbing is limited only by the power of the grip and the tensile strength of the cable. The grip is usually of the toggle joint form, and consequently, if necessary, a cable car can be made to take a grade practicable for nothing else except a cog-wheel road. Of course such excessive grades are neither desirable nor economical, but now and then they are almost unavoidable. Sharp curves can, of course, be employed on a cable system, but with disastrous effect on the life of the cable and the efficiency of the system. The wear and tear on a cable with many curves is very severe.

With horses very steep grades are exceedingly objectionable, but by the aid of hill horses can be taken, except in slippery weather. At best horses are far inferior to the cable system for grade work, though a horse car can safely take a curve that nothing else can, for the horses tend to guide and pull around the head of the car while in any motor system there is a certain tendency to jump the track even in spite of guard rails.

With electric roads the case is quite different. The motor cars depend on adhesion alone for hill climbing, and beyond a certain point adhesion fails. In such a car, however, the whole weight of car and contents rests directly upon the driving wheels in most cases, and consequently theoretically the possible grade per cent. should be numerically equal to the coefficient of adhesion. This can hardly be estimated exactly except by experiment in a given case, and street car tracks are generally not carefully enough laid to give good results. The data obtainable, however, would assign something like 20 per cent. as the maximum practicable grade and the real limit probably lies below this. As to the evidence offered by actual experience under working conditions, it is certain that with proper care of the track grades as high as 400 feet per mile can be operated with entire success. This presupposes that the rails are kept in good order and clear of sleet and snow. With extra vigilance in this respect, aided now and then by a little sand, I think it would be feasible to take grades of 500 feet per mile if necessary. Above a 10 per cent. grade the case is rather precarious when we consider the effect of rough weather. Occasional grades of greater pitch may be taken if they are not too long and conditions are favorable. As to curves, the electric roads are practically unlimited, but curves on grade are particularly undesirable and in any case the speed should be reduced and the track well supplied with guard rails. Save on a steep grade there is no likelihood of trouble.

As regards reliability, one may divide the various systems into two general classes—those in which each car is an independent unit, and those where all the cars have a common source of power. The former class comprises horses and the electrical accumulator system; the latter, cables, and all other modifications of electric traction. All traction systems are liable to occasional local mishaps, but a general breakdown is very improbable in the first class, while in the second it is likely now and then to occur. In the cable system this is most likely to be caused by breakage of the cable itself, either as a whole or in part, *i. e.*, the snapping of one or more strands. In the former case the system is paralyzed until the cable can be repaired, a period usually of several hours; while if the trouble comes from a broken strand or two, the loose wire can be cleared away in a few minutes and the cable run until stopped for the night, when a new strand can be inserted.

With the usual electrical systems a general stoppage, except in very rare cases, is due to a single cause, a serious short circuit at some point on the line. The wiring is usually arranged so that a broken wire, aside from the contact wire, causes no serious trouble, and even if the contact wire breaks, only a short section of track is thrown out of service. If a bad short circuit occurs, however, it may become necessary to shut down the entire line. But such an accident can be remedied almost as soon as the scene of it can be reached, and a broken wire is very easily mended. Electrical roads are, however quite liable to minor accidents to single cars. Brushes will turn, trolleys will come off, gears will occasionally break, field coils will now and then burn out and local short circuits occur. Most of these mishaps can be soon remedied, and not a few of them averted by a vigilant system of car and line inspection. In fact I think it would be quite safe to say that three-fourths of these local accidents can and should be prevented.

Great power of varying speed is one of the characteristic advantages of the electrical systems. The speed may range from four or five, to fifteen miles per hour at will, each car being separately driven and controlled. As the ordinary running speed is considerably below the maximum, trains can be made up quite readily, and the speed lowered very much in crowded streets without resorting to stops and starts. Horse cars possess something of the same flexibility, but their maximum speed is so low that with modern needs for rapid transit the horse car must eventually disappear. As is well known, cable roads work virtually at a fixed maximum speed and can only slow down by letting go the cable.

The same qualities that give an electric car a widely varying range of speed give it also the power of starting very smoothly and easily. In this respect it is decidedly superior to the cable cars, which, although they can be made to start with tolerable ease, usually do not. In addition, the electric car possesses an almost unique power of stopping suddenly in case of need. In a crowded street, it not infrequently happens that man or beast slips directly in front of a moving car. With horses or cable, many accidents have resulted. With the electric car, however, the cases would be exceedingly rare in which a prompt reversal of the motors would not avert such a result, for if there is need, an electric car at full speed may be stopped within its length. I have seen a horse fall on the track within a few feet of a car at ordinary speed, and the car brought to a standstill without touching him. A man has been knocked down by the dashboard and the car

stopped before the wheels reached him. Of course, such sudden stoppage is only attempted in case of dire necessity, but when that necessity comes it can be and is done.

So far as track is concerned, all tramway systems have about the same requirements. In the case of all motor cars of whatever kind there is more or less trouble from frightening horses, and, for a time at least, making the streets dangerous to drive upon. Every place in which a motor system has been started can show a record of a rather serious kind. It is certainly an important consideration. Horses, however, soon become used to motors and the main difficulty is only temporary. But all overhead electric systems, and all using the rail as a part of the circuit, are especially likely to scare horses on account of the frequent flashes from trolley or rails, or blazing at the brushes. I have known horses supposed to be thoroughly used to electric cars to become frightened at a brilliant flash and shy at the cars for some time

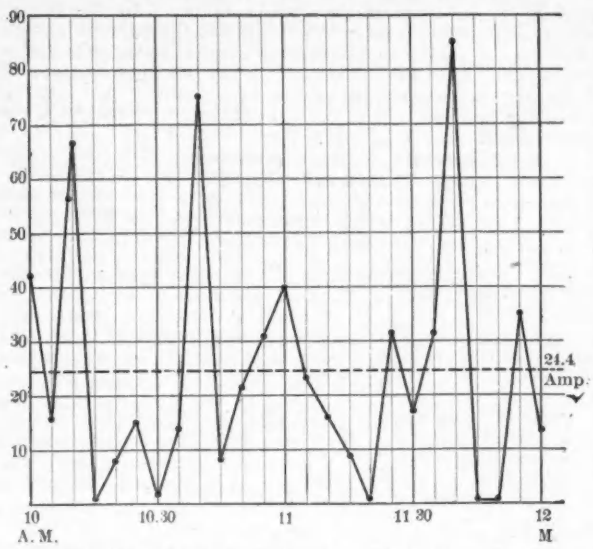


FIG. 1.—VARIATION OF CURRENT, LAFAYETTE, IND., ELECTRIC RAILWAY.

afterwards, even dodging one drawn by a couple of innocent mules. With proper care of line and track, the flashing can be much diminished, however, and with care the difficulty is not at all so serious as might at first appear.

As regards noise, electric and cable cars are at present not widely different. In the electric systems the incessant grinding of the cable all along the line is absent, but the noise of the gearing is often considerable, particularly after it becomes worn. At present gearing seems the most feasible method of reducing the speed of the motors, but except when new, it is far from silent. The noise, however, of either cable or electric cars is not so great as to constitute a valid objection to their use.

With a proper plant, any of the electric systems can handle traffic massed at one point in a way that leaves little to be desired.

Aside from the general conditions to be met, an electric road encounters certain difficulties quite peculiar to itself, some of them real, others rather to be classed as imaginary. In the first place there is a widespread popular delusion that the overhead wire in general use is exceedingly deadly, and that the track used as return circuit is scarcely less so. As a matter of fact, the maximum potential used in tramway work, 400–500 volts, cannot be classed as even dangerous. It would, of course, be decidedly unpleasant to receive the full effect, but there is no reason to believe that it would imperil life or cause a more serious injury than burns at the point of contact. In fact, a large number of employés of electric roads have received the full E. M F. without injury. In addition the wire is carried so far out of reach that the public cannot get at it, and even if it falls it is soon gotten out of the way. The track return is perfectly harmless. These facts are well known wherever an electric road has been in operation for any length of time, but the use of very high potentials for arc lighting has given the electric current a popular notoriety that it does not deserve.

It is, nevertheless, quite clear that the overhead system must be abandoned in large cities, except in some few special cases. Eventually all wires must and will go underground in such situations, and electric tramways, like electric lighting systems, must face the difficulty. That this difficulty is a real one no one who has watched the progress of underground work will care to deny, but the ostentatious collapse of certain electricians under the weight of the problem is hardly in keeping with the skill and readiness they have heretofore displayed.

Fortunately the case for tramways can be easily solved either by a conduit or storage batteries. Which of the two will furnish the ultimate solution of the problem depends mainly on the progress made in accumulators within the next few years. Could the accumulator be reduced to a reasonable weight it would certainly furnish the ideal method of electric traction.

There is one question, however, that is of great and growing seriousness in electric traction, and that is the interference of an electric tramway of the ordinary type with the telephone lines in the vicinity. First, there is the danger of a cross circuit between their respective wires where the damage will be all on one side; and second, the fact that an electric tramway using ground connections may quite paralyze all the telephone circuits in the immediate vicinity. The first danger may be in great measure avoided by a proper system of guard wires, but the second difficulty is of no small moment, and cannot so easily be met.

The effect of a traction line on all neighboring telephone lines is very marked, in some cases rendering them almost useless. The exact nature of the phenomena produced is very complicated. Listening at a telephone thus affected, it is possible to follow in considerable detail the operation of the motors. Whenever a car is started, a low hum is heard, gradually rising in intensity and pitch as the speed increases, and as the connections are shifted from step to step on the switch box. Beneath this distinct note is a confused whirring sound of lower pitch and greater intensity. The effects are clearly due to the superposition of several different periodic variations in the current and electromotive force on the traction line. The transference of this disturbance to the telephone line depends on two quite distinct causes; first, the direct effect of induction, and second, the disturbance due to the fact that both systems are grounded at points not very far distant from each other. The relative importance of these two causes varies very widely in different places. Here most of the trouble comes from direct induction, while it is not uncommon to find nearly all of it coming from the grounds. Both causes must in general be eliminated to avoid the difficulty.

Examine first the cause of the fluctuations which produce induction. Any motor the armature of which is wound in a finite number of sections must, in the first place, produce sinusoidal variations in the motor electromotive force. These, however, are of small amplitude, less than one-half per cent in motors generally used, and are in this case of minor importance. Their period corresponds to Nn per second, where N is the number of revolutions per second and n the number of segments in the commutator.

Besides this there is a periodic variation of the ohmic resistance of a motor due to the fact that the brush in sliding from segment to segment momentarily short circuits the ends of an armature coil.

Let n be the number of armature sections and r the resistance of each, R_1 the resistance of the armature from brush to brush, and R_2 the resistance of the series field coils. Let the motor be supplied, as is usual, in practice at a constant electromotive force. Then, assuming the brushes to be 180 degrees apart and touching one segment the resistance of the motor is—

$$R = \frac{n\,r}{4} + R_2.$$

Now, revolve the armature until each brush touches two segments, and—

$$R = \frac{(n-2)\,r}{4} + R_2.$$

Therefore when the motor is running at a constant speed the current will be subject to fluctuations of amplitude determined by the above, and occurring $n\,N$ times per second.

Take, for example, the ordinary Sprague motor where $n = 24$, $R_1 = 1.2$, $R_2 = 3.3$ (last step) $r = .2$, the amplitude of the fluctuation is somewhat over two per cent. of the normal current.

As the cars are fitted with two motors in parallel, if the two sets of brushes short circuit simultaneously we should have a double effect and a variation of two per cent. in the total current through the car. If they do not short circuit simultaneously, a variation of half the amount $2nN$ times per second.

Another small periodic disturbance is due to the fact that the brushes are very generally unsymmetrically placed, with the result that the motor electromotive force in the halves of the armature will be slightly unequal. The result is as if a weak alternating current were acting in the armature with $2Nn$ alternations per second.

Another and more serious difficulty occurs when the insulation between the commutator segments is somewhere near the width of the contact edge of the brush. In this case there would be produced a fluctuation which might almost amount to a make and break, and would have N periods per second if the brushes were symmetrical, and $2N$ if they were not. The fluctuations due to this cause are frequently considerable. Add to this the possible irregularities in the commutator contact, and we have a combination of sinuous and alternating disturbances of an immensely complicated kind.

Of course, the remedy for induction is well known—giving the offending current a return wire, so placed as to neutralize its effect, or adopting a similar process with the line disturbed.

The case of earth disturbances has recently been investigated by Mr. Preece (*The Electrician*, Vol. XXII., p. 618). His results show that the effect of a grounded sinusoidal current may extend to a great distance and may cause very much worse disturbance on a telephone line than simple induction.

These facts would suggest that in all electric traction work a complete metallic circuit should be used, and that grounding *via* the rails should be avoided.

Double contact wires, however, are certainly objectionable where they have to be supported by a system of wires, both as being somewhat troublesome mechanically and as being unsightly. Unless guarded with great care they will much increase the danger of troublesome short circuits. Where, however, they can be supported on brackets, and hence more efficiently guarded, their use should furnish an effective way out of the telephone difficulty.

But in very many cases it is desirable to use the single overhead wire, and some simple means of avoiding at once earth and induction is desirable. Clearly it is not sufficient to use the track alone for a return or the track with an auxiliary wire beside it, as is quite usual.

For the current of supply is, or always should be, divided between the trolley wire and a line wire connected with it at intervals, hence the inductive effect of this overhead system can never be balanced by an equal current along the ground by reason of unequal distance from the overhead telephone wires.

I would, therefore, suggest the following as perhaps the simplest and easiest way of abolishing the induction: Connect the rails so as to form a return circuit leading either back to dynamo or to a main earth at some unobjectionable point. Ther remove the auxiliary wire from the track to form a second return circuit parallel to the line and nearer than it to the telephone lines. Finally connect these two return systems at any convenient number of points by wires under the surface and up the nearest pole. Neither track nor these cross wires need be carefully insulated.

The supply current then is divided between line and trolley wire and the return between auxiliary line and track. The most of the former current would pass along the line wire and most of the latter along the track. Since the coefficients of self-induction will be quite nearly equal, the disturbing fluctuations will divide in the same ratio as the currents, and we have a system of four conductors in which the two fixed ones, trolley wire and track, nearly neutralize each other, the larger current being the more distant from any overhead wires; while the two movable factors, the two-line wires, can be so arranged as to complete the compensation. Given the resistances, such a system can be easily arranged, so that the resultant induction on any single wire would be *nil*, and remain very small throughout any compact system of wires. It would be practically very difficult to secure compensation with fewer conductors than four so long as two of them must be approximately fixed. This four conductor system could be applied to existing lines with small trouble and expense.

I will now pass to the efficiency tests made on the electric road in this city.

The Lafayette Street Railway Company operates 3.6 miles of single track on the Sprague system. The line was operated by horses until the summer of 1888, and has now been operated as an electric road about eight months. The track is a branching one, extending on both sides of the Wabash River and reaching well out to the city limits. The grades are in some places severe. In the central part of the city which lies in the old river bottoms the grade is very light, but on the east side the road rises sharply, taking at first a slight grade and then one of about 6.6 per cent. and fully 800 feet long, averaging 7 34 per cent. for 100 feet in one section. On the west bank of the Wabash the road rises over the bluff, taking a 6 per cent. grade for about another 800 feet, with a very sharp curve near the middle point. There are more than a dozen curves in the road, most of them of a rather short radius.

There are seven motor cars, of which six are in continuous use. The cars are closed, weigh complete about 5,200 pounds, seating 20 persons readily, and holding at a pinch between 40 and 50.

The plant combines a plant for stationary motors with that for the street cars. There are two of the regular Edison railroad dynamos coupled in parallel, each having a normal capacity of about 30,000 watts at 500 volts, or rather more in case of need. Two other Edison dynamos of about half the capacity supply the power circuit at a potential of about 250 volts.

Power is supplied by a Hamilton Corliss engine, 14 inches by 36 inches, running at 88 revolutions per minute. Two large horizontal tubular boilers furnish steam at a normal pressure of 85 pounds, and have a large margin of capacity. The two railroad dynamos and one of the power dynamos are used continuously, the former 16 hours, the latter 10 or 12 hours per day. The first car leaves the end of the road at 6:20 A. M., and the last car gets in at 10:20 P. M. Each car makes from 35 to 40 miles per day, is operated by a single man, and can, if necessary, take one of the spare cars in tow to accommodate an unusual crowd.

The first tests were made at the power station, with the object of determining the actual electrical output on the road, the indicated horse power necessary to produce it, and the amount of coal required. To this end the engine was indicated every five minutes throughout the day, beginning and ending this series with a group of friction cards. Meanwhile the electrical output was simultaneously obtained from volt and ampère readings. The volts were read on an Ayrton & Perry voltmeter, and the amperes on the station ammeter, which was afterward checked as well as practicable by a new Ayrton & Perry ammeter. The coal burned during the test was measured and its weight determined.

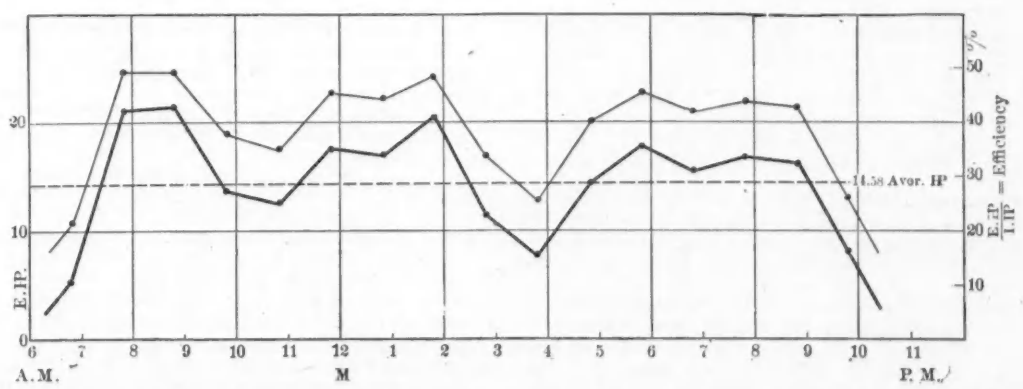


FIG. 2.—VARIATION OF ELECTRICAL H. P. AND EFFICIENCY, LAFAYETTE, IND., ELECTRIC RAILWAY.

The results of the friction cards were as follows:

Friction of engine + 3 dynamos average: Morning, 12.5 I. H. P.; night, 19.1 I. H. P.

A number of cards taken on different days gave almost exactly 16 I. H. P., which we may take as a fair average for the power wasted in friction. The dynamos are all belted to a main shaft which is driven by a belt from the engine.

This shaft is well in line and kept in good order. In fact, the station is a model of neatness and the machinery is looked after with unusual care.

These figures give for the approximate friction of the engine alone 12—14 I. H. P. In other words we may take the engine friction as 70 per cent. of its rated full power.

The five minute indicator cards were worked up very carefully, and gave as the average continuous power throughout the day 39.05 I. H. P. The highest figure reached was 79.3 I. H. P., and from this figure the power fell to the friction cards as a minimum.

In a similar way the readings of volts and ampères were combined and showed an average that was remarkably low, being 10,881 watts, equal 14.58 E. H. P. The greatest output recorded was 90 A., 410 V., 36,900 watts, equal 49.46 E. H. P. This figure was reached only for a few

seconds. This is not as great an output as is sometimes observed on the line, where occasionally 75 E. H. P. may be demanded, though such a call for power is quite unnecessary under ordinary working conditions. The ammeter readings not infrequently fell to zero for a few seconds at a time.

To obtain the total electrical horse-power for comparison with the indicated horse-power, we must add to the above the amount obtained by a similar approximate integration of the power used on the stationary motor line, which was 1.25 E. H. P.

The ampères on the car line varied from 0 to 90 and the volts from 405 to 480, averaging about 450. A sudden call for a large current invariably lowered the potential to about 410 and tended to slow the engine momentarily, for the governor only began to act some two seconds after the current rose; and so sudden are the variations in current that nothing short of compound winding can possibly keep the dynamo at anything like constant potential.

The electrical output varied greatly during the different hours of the day. Fig. 1 gives this variation of the output with the time in a very marked way. The heavy line gives the E. H. P. required hour by hour. The variation is very large, and causes a similar variation in the efficiency of the power station, since the main losses are nearly independent of the output.

Combining now the I. H. P. at the engine with the E. H. P. on the car line, and making proper allowance for the power consumed in the lamps and on the stationary motor line, we have as the average efficiency of the power station, $\frac{\text{E. H. P.}}{\text{I. H. P.}} = 40.7$ per cent. average throughout the day, and for the maximum efficiency, $\frac{\text{E. H. P.}}{\text{I. H. P.}} = 65.0$ per cent.

The light line in Fig. 1 gives the variation of the efficiency throughout the day.

The coal burned during the day was 4,500 pounds of slack, which is at the rate of 7.3 pounds per I. H. P. hour, or nearly 16 pounds per E. H. P. hour. We have shown in these facts by far the greatest source of loss in electric traction, both here and elsewhere. It is worth while considering in some detail the nature and cause of this loss, in how far loss at this point is necessary, and what means can best be taken to lessen it. The key to the whole situation lies in the immensely irregular calls for power in a tramway system.

The cause of this irregularity is obvious; the annexed diagram (Fig. 2) will give a feeble idea of its amount. It shows the variation of the current on the line as given by the five-minute readings between the hours of ten and noon on one of the days of test. Comment is unnecessary. But even this does not represent the real amount, for as a matter of fact the current is never even approximately constant for more than a few seconds at a time, and varies from *nil* to 60 or 70 ampères in a way that nothing but a continuous record can show. As a result of this the mean output is, on a system of this size, less than 25 per cent. of the maximum, which may be called for and must be furnished at any moment. As the system becomes larger the ratio of mean to maximum output increases until for a large system it may amount to one half. The value of this ratio on the Richmond (Va.) road, judging from Mr. Sprague's figures, rises to nearly this amount. The values will then range from .20 for a small road with high grades to .50 or .60 for a large road (40 or 50 cars) in a level region. Grades evidently tend to diminish its value considerably, though their effect may be partially counteracted in a small road by tact in arranging the schedule.

To supply power to such a system an engine must be able to give the maximum power demanded on very short notice, and will be habitually worked at from a fifth to a half of its full horse-power. This affects the efficiency of the system in two very pernicious ways, first, by requiring the use of a disproportionately large engine with friction to match, and second, by working that engine in a very uneconomical way.

As regards the first count, the friction of an engine is nearly independent of the load, quite as often decreasing under heavy load as increasing. It gradually increases with the speed, and slightly increases with increasing length of cut-off. As to the amount of friction it varies, of course, very widely, but in modern engines of good make it will generally be from 5 to 10 per cent. of the full normal output.

This means, then, that if such an engine be worked on the average at a quarter of its full power the loss from friction will be from 20 to 40 per cent. of the indicated horse-power, usually much nearer the latter figure than the former.

This is bad enough, but it is not the worst. When used under these circumstances, an engine is on the average working under conditions of expansion very far from economical. The cut-off is very much too short for advantageous working. The best point of cut-off is probably given by Emery's formula:

$$\frac{1}{r} = \frac{1}{1 + \frac{p}{22}}$$

Where r is the ratio of expansion and p the absolute pressure in pounds per square inch. Even this point of cut-off is probably rather small for ordinary engines. Applying the above formula to the case of the engine tested in these experiments, the best point would appear to be between one-fourth and one-fifth stroke. On examining the indicator cards taken at or near the point of average output, the engine seems to be cutting off at between an eighth and a ninth of the stroke. There is, therefore, a disastrous amount of condensation, and the final result appears in the 7.3 pounds of coal per I. H. P. hour. A Corliss engine like the one in question should, if used under favorable conditions, give the I. H. P. hour for three pounds of coal or less, while under this erratically varying cut-off, it requires more than twice that amount. It is very important then to avoid as far as possible these very wasteful conditions of working. The problem then is to work an engine on the average at its most economical point of cut-off, while retaining the power of responding to sudden, though brief, demands for several times the average horse power. In the first place, these sudden demands are sometimes but for a second or two, generally for less than half a minute, and whatever the engine used, a heavy fly-wheel would be of great service in smoothing the irregularities of the output and helping the engine through a sudden emergency. Second, the engine itself should have a very wide range of cut-off to enable one to make the average expansion the most economical one. In an engine which must be habitually used at one-fourth power, the steam should be made to follow for nearly full stroke if necessary, in order to bring the average point of cut-off to the right value. Any valve gear which cannot cut off beyond half stroke is decidedly objectionable, since it necessitates too large an engine and too great a ratio of expansion.

To avoid friction as well, the engine should be the smallest, competent to furnish the maximum power; hence it should take high pressure steam and have a high rotational velocity. As regards application of power, it should be as direct as possible, avoiding countershafts and the like. All these considerations point distinctly to the use of high pressure steam in a rather small high speed engine capable of cutting off up to three quarters stroke, driving a heavy fly wheel, and belted direct to the dynamos. Such engines can be obtained and are capable of giving the I. H. P. hour on 3 to 4 pounds of coal. The day of low speeds and gigantic cylinders is fast passing by, and nowhere do they appear at less advantage than in work under extreme variations of load. An engine of the kind mentioned above would, under favorable conditions, have a coefficient of friction not exceeding 15 per cent. of the average I. H. P., and require less than 5 pounds of coal per I. H. P. hour, even under the variable load necessary. It should then be able, when belted direct to the dynamo, to give the electrical horse-power hour for about 7 pounds of coal. The load being less variable in a large power station, conditions of economy are more easily reached, and as nearly as can be calculated from Mr. Sprague's data in the power station of the Richmond, Va., road, the E. H. P. hour required about 9 pounds of coal.

As to the amount of power actually needed to operate a tramway line, the tests made here show almost exactly 2.5 E. H. P. per car. This is a smaller value than would be obtained from a larger and more heavily loaded line. The diagrams given by Mr. Sprague show that on the Richmond line the power required was approximately 4 to 5 E. H. P. per car. The Richmond cars, however, are larger and heavier than those here. In general, the power required seems to be 3 — 5 E. H. P. per car. To furnish this output the engine should be capable of producing about 10 to 15 I. H. P. per car, at full (say $\frac{1}{4}$) cut-off, the former figure for large and level systems, the latter for small systems and those with excessive grades. It should then be practicable to bring the efficiency of the power station, $\frac{\text{I. H. P.}}{\text{E. H. P.}}$, up to 70 per cent., in lieu of the 40 per cent. observed in these experiments. The efficiency of the Richmond system, which is operated by Armington & Sims engines running at 250 revolutions per minute must be somewhere near this figure, certainly as high as 60 per cent. This efficiency, it should be remembered, is not secured at any great expense, for such a plant is quite economical in first cost as well as in operation.

The next experiments were to determine the losses on the line. These were found from observations of the fall of potential between power station and cars, taken both on regular and special trips. The efficiency of the line is a constantly varying quantity, changing, of course, with the position and ohmic resistance of the motors. A general average along the line showed an efficiency of 90–95 per cent.

Attention was next turned to the speed and efficiency of the motors. The observations were confined to a single car, No. 106, which was a good average car in its general performance. As a preliminary the resistance of the motors and connections was measured with the switch in each successive step. These resistances measured cold were:

Step.	R.	Step.	R.
1	10.76	5	2.83
2	6 98	6	2.83
3	6.98	7	2.17
4	5.44		

The resistance of an armature cold was 1.2 ohms, measured from brush to brush.

Two spaces each of $\frac{1}{10}$ mile were then measured off, one on a level, the other on a grade of 6.58 per cent. average. Experimental runs were then made with car No. 106, carrying 19 persons and instruments. The total weight of car and contents was 8,200 pounds. The runs were made in each case with a flying start; each step of the switch being separately tested.

The results of an experiment on the level were as follows:

Step.	Miles per hour.	Volts.	Ampères.	E.H.P.
1	7.5	404	9.5	5.15
2	9.3	416	10.4	5.79
4	9.1	393	10.7	5. 4
5	10.9	434	16.1	9.35
7	12.4	433	15.4	8.93

The somewhat anomalous result in step 4 is due to the very considerable drop in voltage.

From these experiments the efficiency of the motors may be deduced, and since the motors are geared down very nearly 12 times, the armature speed can also be obtained. In computing the electrical efficiency of the motors allowance must of course be made for increase of ohmic resistance due to heating, for self-induction, hysteresis, etc. Following Mr. Sprague's own figures, I have allowed 10 per cent. increase in resistance by heating. It is my firm conviction that this, under favorable conditions, will more than cover the above losses. Nevertheless the loss due to hysteresis must be quite considerable. Computing this by Hopkinson's method for an approximate size of core, and an armature speed of 1,200 revolutions per minute, it appears that the energy spent in hysteresis may amount to somewhere nearly 500 watts. The loss of energy due to sparking may also rise frequently to a quite perceptible amount.

Computing then the electrical efficiencies under the various conditions we have the following results:

Step.	Armature speed.	E. H. P.	Motor E. H. P.	$\frac{\text{C e}}{\text{C E}}$ Per cent.
1	1,000	5.15	3.72	72.3
2	1,230	5.79	4.67	80.7
4	1,200	5.64	4.74	84.2
5	1,150	9.35	8.29	88.7
7	1,650	8.93	8.18	91.5

Unfortunately a car motor does not lend itself at all readily to brake tests, the conditions of such a test being widely different from those under which the motor works. We can, however, obtain an approximation to the commercial efficiency by computing as nearly as practicable the coefficient of friction on track, and then applying this to the data obtained on a known grade to estimate the work actually done.

Assuming, then, a loss of 10 per cent. in friction of motors and gearing, in accordance with Mr. Sprague's own estimate, and using the data above, the coefficient of friction appears to be two per cent.; in other words, 40 pounds per ton. This is a high value, but, I think, justified by the condition of the track.

Substituting this constant in the formula used with the results of the grade test, we can obtain a close approximation to the commercial efficiency, and a check on the above estimate of 10 per cent. friction.

The grade tests were with the same car and load. The results were as follows:

Step.	Miles per hour.	Volts.	Ampères.	E.H.P.
2	2.73	347	27.2	12.65
4	4.2	403	27.4	13.47
5	9.3	409	31.3	17.14
7	6.2	365	32.4	15.85

The general voltage here was rather low, produced in part by the location of the grade relative to the power station, and mainly to heavy demands for current during the test. It serves to emphasize what I have previously mentioned, the advantage of using compound wound dynamos on tramway work.

Computing now the electrical efficiency by means of the above data:

Step.	Armature speed.	E. H. P.	Motor E. H. P.	$\frac{\text{C e}}{\text{C E}}$
2	333	12.65	5.06	39.9 per cent,
4	545	13.47	7.98	59.3 "
5	840	17.14	13.04	76.1 "
7	830	15.85	12.50	78.9 "

Step 1 was not tried on the hill on account of endangering the field coils. Notice for example that in case of step 2 there is 7.59 E. H. P. spent on internal work. No coil can stand such treatment for any length of time, and with this light it is quite easy to see why fields and armatures burn out. On a grade like this, nothing short of full power should ever be used.

Compute now the actual work done by the motors on this grade, using the above data and the friction coefficient previously found. We have then virtually the brake horse-power, and hence the commercial efficiency $\frac{\text{B. H. P.}}{\text{E. H. P.}}$

Step.	M. E. H. P.— 10 per cent.	B. H. P.	$\frac{\text{B. H. P.}}{\text{E. H. P.}}$
2	4.56	4.67	36 9 per cent.
4	7.19	7.65	56.9 "
5	11.74	11.80	67.6 "
7	11.35	11.61	73.2 "

The agreement between the second and third columns shows that the estimate of 10 per cent. for friction of motors and gears was substantially correct. A second approximation could, of course, be deduced. It appears therefore that the motors with their gears may reach an efficiency of over 80 per cent. on the level, or over 70 per cent. on a severe grade when used under favorable conditions. When used with the lower steps of the switch the resistance of the field coils is so high as to reduce the efficiency enormously. In other words, when the cars run slowly they do so at the expense of greatly diminished efficiency. Still, less power is used, and if the field coils are well insulated, the lowest step of the switch sufficient to give the required speed will be the most economical one. On grades, however, the fifth or seventh step should be always used to avoid excessive heating. The very high ohmic resistance of these motors is a source of continual loss, as has been pointed out in detail by Mr. Snell (*The Electrician*, Vol. XXI., p. 522), and is the cause of unnecessarily great destruction of field coils. It may be possible to so insulate the coils as to withstand the roasting to which they are too often subjected, but this is a questionable way out of the difficulty.

From observations on the cars during regular trips, the average electrical efficiency in ordinary use appears to be about 75 per cent., and the commercial efficiency of motors and gearing 65 to 70 per cent.

We are now in a position to obtain the approximate efficiency of the entire system $\frac{\text{B. H. P.}}{\text{I. H. P.}}$

The mean value for this line as at present worked is about 25 per cent. The chief cause of this low efficiency has been already pointed out. The figure will probably be considerably increased before long by the increasing use of stationary motors, which will raise the mean electrical output to something like the proper figure. As a system increases in size the efficiency will rise, and in a system as large as that at Richmond the total mean efficiency would appear from the data obtainable to be a little over 40 per cent. This may seem a low figure, but it should be remembered that traction work is probably the least favorable to high efficiency of any task to which an electric motor can be put.

Most of the losses incurred are unavoidable; engines will not run without friction, dynamos are not of ideal efficiency, line wire will have resistance, an electrical current will generate heat in the motors and gears will grind and wear. Losses like these cannot be avoided or reduced below certain limits. These limits are not easy to set, but one can safely say that a total mean efficiency, $\frac{\text{B. H. P.}}{\text{I. H. P.}}$, of anything over 50 per cent. would be a very remarkable performance for a traction system in actual use.

I do not think that 60 per cent. is likely to be reached without very radical improvements. This applies of course to the direct supply systems. The storage battery requires a separate investigation. In that case the power stations can be worked to rather greater advantage than with direct supply, since the load can be made much more regular. There is no loss by line wire but there is a very serious loss in the accumulators themselves. The laboratory efficiencies of storage batteries rise to a most tempting amount, 80 per cent. and over, but the irregular discharge rate necessary in operating a tramway is even more disastrous to the efficiency of a storage battery than to the efficiency of an engine. With any accumulator now made, a mean efficiency of over 65 per cent. is doubtful under the conditions which exist in tramway work. There is great need of careful tests under something like working conditions, but so far as I am aware none have been published, at least none of any scientific definiteness. I may here remark, that, with very few exceptions, the reports published on electrical traction work are models of how to avoid giving definite information.

Perhaps the most serious charge against the accumulator is its very great weight. It appears to require about thirty-five hundred pounds of battery to operate a car successfully, and this amount must be carried as well as

the passengers. Of the total electrical output then, something like 25 per cent. is employed in dragging around this dead weight. But this is not all. Sit down with a list of storage batteries and compute the weight required to furnish the car say 10 E. H. P. The fact at once appears that if we undertake to supply from storage batteries the same amount of power we supply from a line, we shall need something like twice the above weight of storage battery. In short, the weight of battery is reduced by reducing the supply of power.

Nevertheless, the storage system is deserving of consideration. Each car is a unit, there are no conduits or overhead wires, there is lessened danger of breakdowns, and independence generally. If the storage battery comes to be of reasonable durability and weight, it will furnish an ideal solution of the tramway problem, particularly for city work where overhead wires are a nuisance and conduits are troublesome.

Given a mean efficiency of 60 to 70 per cent for the accumulators, it is easy to form a pretty clear idea of the total mean efficiency of the storage system. The power station will be somewhat more efficient than with direct supply, $\frac{\text{E. H. P.}}{\text{I. H. P.}}$ being perhaps 80 per cent.; the batteries will be of, say, 65 per cent efficiency, and finally the motors will be about as before, giving a total efficiency of a little less than 40 per cent. In practice this is diminished by the fact that for the same service the storage system car would require from a fourth to a third more power on account of its constant load of battery. So far as efficiency is concerned, there seems to be little prospect of the storage system equalling direct supply, since the loss on the line is so small compared with that in the battery.

Probably the most effective rival of electricity is the cable traction system, and it is well to look into its efficiency a little. Facts are not particularly easy to get at. Some of the theoretical discussions of transmission by wire rope give a preposterously high efficiency. A valuable paper, however, in the Journal of the Association of Engineering Societies, September, 1888, gives some interesting and authentic figures as to efficiency, details of construction and cost.

The St. Louis & Western cable road, having a cable in one piece 34,600 feet long, required 185 h. p. to drive the empty cable at the rate of eight miles per hour. Regular capacity of the road 40 cars (20 trains of grip and car). Under ordinary conditions of traffic 180 to 190 h. p. additional was required to operate these cars, 9–9.5 h. p. per train. Curves are numerous on the road.

The Fifth street road, Kansas City, operates 40,000 feet of cable. The conditions of working are better than at St. Louis, there being few curves. Twenty trains are operated, taking under usual conditions 280 I. H. P., 120 of which is required to drive the cables at the rate of 8 miles per hour, leaving 8 h. p. per train as the power required.

In these roads then, 50 to 60 per cent. of the indicated horse-power seems to be applied to doing useful work.

It is instructive to compare this performance with that of the Richmond electric road, which operates single and double track, covering 8.8 miles of streets, and 40 cars aggregating almost exactly the same weight and seating capacity as the above 20 trains. The mean electrical output at the power station is per car 4-5 E. H. P. Making due allowance for loss in the power-station it appears that the total power required to operate the system is about the same as in the Kansas City cable line, and distinctly less than in the St. Louis cable. The curves and grades in Richmond are more severe than in the Kansas City line.

We may conclude then that in the case of good-sized systems the power required to operate is nearly the same with cables and electricity; the former having the advantage on short and easy lines, the latter on long and difficult ones. On smaller systems electricity has a decided advantage since the loss of power in the motors depends on their number, while the loss in dragging a cable is constant.

But there is another side to this comparison, the economic one. A cable road costs $50,000 to $75,000 per mile, owing to the large and complicated sub structure. This does not include power stations or rolling stock. This cost is four or five times greater than for an electric overhead road, even under unfavorable conditions, and something like twice as great as for an electrical conduit system. This comparison supposes the electric road to be laid and wired in the most efficient and permanent way. Under ordinary circumstances the difference in first cost would be even greater. The difference in running expense is not so easy to estimate. Not far from the same amount of power is required, though it is probably procured at rather less expense of coal in the cable system. The number of employés cannot be widely different, the difference being of little moment. The cable conduit, however, requires decidedly more care than the electric line, supposing the latter to have been properly put up in the first place.

As to repairs, on an electric system using overhead wires, the line if properly put up and occasionally aligned should give very little trouble. The trolley of whatever description is subject to constant wear and must frequently be renewed or repaired, and the brushes rapidly wear out. On some lines the wear of brushes amounts to almost a set per week per car. There is great chance for improvement here. The field coils now and then burn out, in some cases frequently, and occasionally an armature is damaged. On a cable line the cable itself is a considerable item of expense. Its life may be from six to eighteen months, though occasionally only a few weeks; and the expense of renewal is considerable. The grips are subject to continual wear, the dies that form the jaws generally lasting only a week or ten days. The running gear along the line requires constant watchfulness and attention and the minor repairs on this must be considerable. As regards the comparison of actual operating expenses it is almost impossible to get definite information. Both cables and electricity are distinctly cheaper than horses. Reports from the Chicago cable roads indicate expenses about 50 per cent. of the cost of operating by horses. From this the figure may rise to 75 per cent. Reports of anything like a definite kind from electric roads are scarce. Such scattered figures as can be collected tend to show that the operating expenses are about the same as for cables on systems of the same size. Details of operation vary so much from place to place that it would at present be unjustifiable to say more than this. The detailed reports from electric roads have for the most part been from very small ones. A recent one from the Davenport, Ia., road shows expenses 97 per cent of those with horses the previous year, and net profit three times as great. This road operates only four regular cars. One or two small English roads report something of the same kind, slightly diminished expenditures and greatly increased receipts.

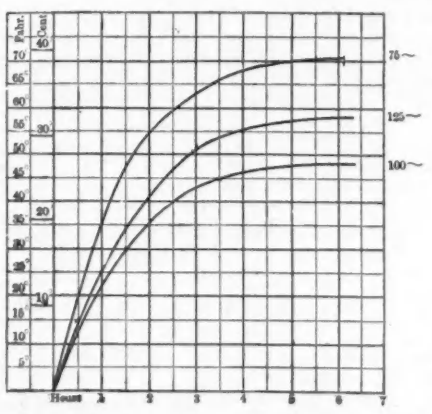
In closing it seems worth while to say a word about the use of electricity for ordinary railroad work. In elevated roads there can be little question about the matter; the smoke and dust of the locomotive are quite enough to condemn it, and as the consumption of coal is over 6 pounds per horse power hour, an electric system can push it hard in the matter of economy. In ordinary cases, however, there is no call for sacrificing economy for the sake of the characteristic advantages of an electric system. It is quite possible for a locomotive to give the horse-power hour on 4 pounds of coal, a figure which can probably be reduced. This leaves no very large margin for the double transformation of an electric system. In fact so long as we have to depend on the steam engine and dynamo for our supply of electricity, competition with the direct use of steam in locomotives will be hopeless. Even water power will not be of much avail, and the longer the line to be operated the less chance of success. If we could get electricity directly from heat in any economical way the problem of power would be solved.

Finally, with regard to electric traction systems, most lines of road are not laid and wired with sufficient care, and most of the minor difficulties in operating come from this fact. A line with track hastily and imperfectly laid, with wiring carelessly put up on rickety poles, and imperfectly aligned, will surely encounter plenty of small but exasperating difficulties and bills for repairs that will be anything but pleasant. A vigilant system of car and line inspection will avoid most of the little accidents that interrupt traffic and will more than pay for itself in lessened repairs. With a carefully constructed line, and a properly designed power plant, electric traction becomes thoroughly reliable and remarkably economical. Without these it may be very uncertain in its operation, and while it will nearly always pay, the size of the dividends will not be pleasant to contemplate. If much power is to be used for stationary motors, it is better, and in the long run cheaper to divide the plant than to rely entirely upon a single engine.

I cannot close this paper without expressing my obligation to Mr. Hawter, superintendent of the road, who has facilitated this investigation in every way possible, and to Messrs. F. W. Brady and W. J. Lutz, post-graduate students in this university, for most efficient aid throughout the tests.

Mordey on Alternate Current Working.

On Thursday last, says our London correspondent, under date of May 29, a long and interesting paper on "Alternate Current Working" was read before the Institution of Electrical Engineers by Mr. W. M. Mordey. The



MORDEY ON ALTERNATE CURRENT WORKING.

paper was listened to throughout with the greatest attention, and we may anticipate a very warm discussion, since Mr. Mordey has fearlessly upset our preconceived notions on several important points connected with alternate currents. Every line of this paper, which occupied fully two hours in reading, bears the mark of being written by a practical man who has something to say, and knows how to say it. The first dogma attacked by Mr. Mordey was one which has been firmly believed in up to the present time, namely, that alternators can only be run in parallel if they have a large amount of self-induction, to secure which they should have iron in the armature. Now, Mr. Mordey's view is that a perfect alternator should have no resistance and no self-induction, and in support of this statement he proceeded to describe some remarkable experiments with two of his 2,000 volt, 40,000 watt alternators. Each machine was driven by a 75 h. p. Fowler engine, through heavy countershafting. The alternators were run at full speed and excited to give 2,000 volts: when in place they were switched into parallel without any external load or resistance between them and ran perfectly. A large inductionless load was then put on, varied and taken off; they ran equally well in parallel under all changes. The machines were next uncoupled, and then suddenly and simultaneously switched into parallel and on to the mains with perfect success. One alternator was now excited to give only 1,000 volts; the two machines were then switched again into parallel and immediately got into step; a load was then put on with no bad effect. With one machine at 1,000 volts, and the other at 2,000 volts as before, they were switched into parallel *when out of phase*, and still went into step. They were then left running in parallel while one was disconnected from the engine, the belt being shifted on to a loose pulley; it continued to run as a motor synchronously. The two machines were then uncoupled and excited up to 2,000 volts; they were then placed in parallel when out of phase and without any external load, and went into step instantly. While running in this way steam was suddenly shut off one engine; the alternators kept in step perfectly, one acting as a motor and driving the large engine and all the heavy countershafting, the power required to do this being 20 h. p. After obtaining such remarkable results as these with machines generally supposed to be completely unfit for parallel working, it is not surprising that Mr. Mordey calls upon electricians to revise their theories. A very simple means of starting synchronizing alternating current motors was then described. The small excitors usually employed with alternators can, by using a few accumulators to drive them, start the alternators, and when sychronism is attained, the alternators can be switched into circuit, the exciters recharging the cells. Mr. Mordey next dealt at considerable length with the subject of "periodicity." He thinks there is no such thing as a right or wrong "periodicity," everything depending on the circumstances of the particular case in question. Generally speaking, he is in favor of a moderate "periodicity" of about 100 complete periods per second. With regard to the secondary E. M. F. of transformers, Mr. Mordey is in favor of 50 volts for small separate installations and 100 volts for larger ones. In connection with transformers Mr. Mordey again differs from most authorities. In his opinion, the general belief that a high "periodicity" is best for transformers is quite wrong. Every transformer will, he thinks, be found to work more and more efficiently up to a certain rate of alternation, after which its efficiency will fall as the rate of alternation is increased. To obtain the efficiency of a transformer Mr. Mordey runs it on an incandescent lamp circuit in the usual way and measures the secondary output, noting carefully the temperature. When the transformer has cooled down, a continuous current is sent through it, and the power in watts that raises the temperature of the whole transformer the same amount as when working with alternate currents is measured. With these determinations made the efficiency of the transformer can easily be arrived at.

The accompanying diagram shows the rise of temperature of one of Mr. Mordey's transformers, working respectively at 75, at 100, and at 125 complete reversals per second. The primary and secondary virtual potential differences were measurably the same in all three cases, and in each case the same load was used, consisting of a certain number of incandescent lamps. The test was continued each time long enough for the transformer to attain its maximum temperature. The curves give the actual increments of temperature, which may be taken as some sort of measure of the relative efficiency attained. It will be observed that the lowest temperature or the highest efficiency is obtained at 100 complete reversals; that the efficiency is lower at 125 and lowest at 75 complete reversals.

Alternate current arc lamps were next alluded to, the Brush lamp having, Mr. Mordey tells us, been very successfully modified so as to work on alternate current circuits. If the efficiency of arc lamps is measured by the candle-power obtained for a given number of watts, and not only by the current, they are, Mr. Mordey points out, in many cases more efficient than continuous-current arcs. Dealing with safety devices for transformers Mr. Mordey sums up strongly in favor of the plan of earthing the secondary. The last section of the paper was devoted to the question of hysteresis and eddy currents. After emphasizing the importance to dynamo designers of separating these two deleterious effects in order that they may not be led to carry lamination to such a degree of fineness that the cost of construction is materially enhanced without any corresponding gain in efficiency, Mr. Mordey describes a method by which the loss due to each of the two effects may be ascertained experimentally in the workshop on a practical scale. The dynamo is first run on open circuit at various speeds with the fields unexcited, and the power absorbed in friction at each speed is noted. The armature is next run on open circuit with the brushes removed and the field normally excited, the power absorbed being carefully measured. This is the total power dissipated in friction, eddy currents and hystersis. Now as the loss from hysteresis is directly proportional to the speed within certain limits, and as eddy currents also vary as the first power of the speed, and, therefore, the loss due to them varies as the square of the speed, it is easy, by means of a concise formula of Prof. Sylvanus Thompson's, to separate the values which are directly proportional from those which are proportional to the square of the speed. If the armature cores are run in an excited field *before* winding, we are able to go a step further and separate the effects of eddy currents in the core from those in the conductor, and the hysteresis from both. The results obtained from experiments with a 4-pole, direct current, 18-unit Victoria dynamo, run at various speeds, up to 1,200 revolutions per minute, with constant excitation, was as follows: The hysteresis loss amounted to .195 h. p. at 450 revolutions and .39 h. p. at 900 revolutions, while the total loss from eddy currents was respectively .4 h. p. and 1.66 h. p., the loss in the core alone being .3 h. p. and 1.11 h. p. The armature had a ring core nearly square in cross section composed of iron strips only .012 inch thick, separated by paper. The eddies in the core, it will thus be seen, are by no means negligible even with very fine subdivision.

Cornell Electrical Items.

The great increase in the number of students in the electrical engineering course and consequent excessive demand upon the physical laboratory resources, necessitated the making by the seniors of most of the instruments used in their thesis work. This, while the best of practice, has delayed somewhat actual thesis work, and as a consequence but few theses have yet been submitted.

There are two candidates for the degree of master of science in the E. E. course this year: Mr. Hatsuné Nakano, M. E., University of Tokio, who presents as his thesis "The Efficiency of Arc Lamps," and Franklin Sheble, B. S., University of Pennsylvania, whose thesis subject is "Exploration of the Field of Alternating Current Dynamos."

The graduating class this year numbers 20. In addition there are several P. G. students who will take the regular senior degree. Most of these have already obtained positions.

Prof. Thurston left last week for a European trip. He is one of the jurors of award of the Paris Exposition.

Prof. E. P. Roberts has resigned the Associated Professorship of Electrical Engineering. It is rumored that at the next trustee meeting, which takes place commencement week, Mr. Ryan, at present instructor, will be appointed to the vacant position.

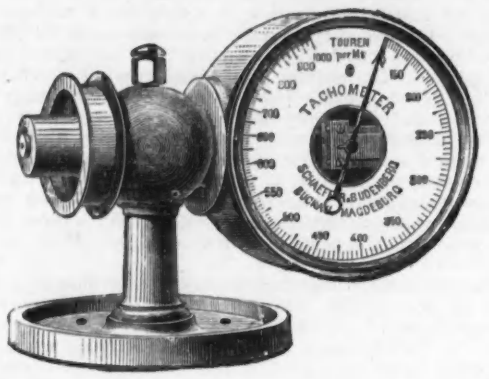
During the summer Mr. Ryan and Mr. Merritt will attempt an accurate determination of the electro-chemical equivalent of silver, using the big tangent galvanometer.

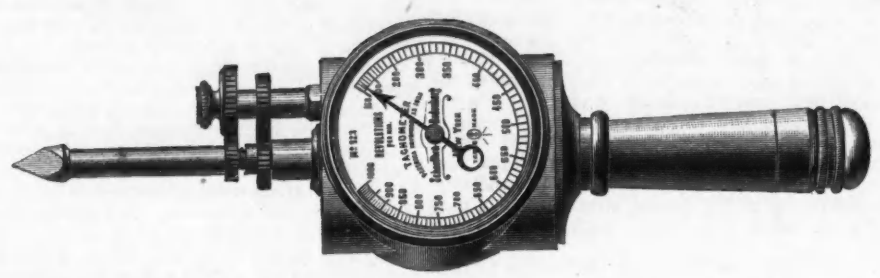
A study of the efficiency of transformers will also, probably, be made by these gentlemen, assisted by Mr. Snow.

The new electrical balance of Sir Wm. Thomson, recently received from Scotland, has been calibrated by reference to the big tangent galvanometer, and is found to agree with it to within less than $\frac{1}{10}$ per cent., thus showing the uniformity of electrical units.

A New Portable and Stationary Tachometer.

Managers of electric light stations in the early days considered it quite sufficient to determine the speed of their line shafting or engines by timing the number of revolutions with a watch. The accuracy attainable by such a method is evidently not very great, and this was soon apparent to those having charge of such stations. It became necessary therefore to provide a means of obtaining continuous and exact indication of the speed of the machines, and this demand was met by the introduction of devices, such as the useful tachometer of Messrs. Schäffer & Budenberg, of Magdeburg, Germany, and this city. The action of their stationary tachometer, as now improved and perfected, shown in Fig. 1, is based on centrifugal force acting against a pendulum ring connected with a fixed shaft and the motion of which is transmitted to a sliding rod and indicating movement. The pointer on the dial shows the exact number of revolutions made by the pulleys per minute, and hence no calculation whatever is required.



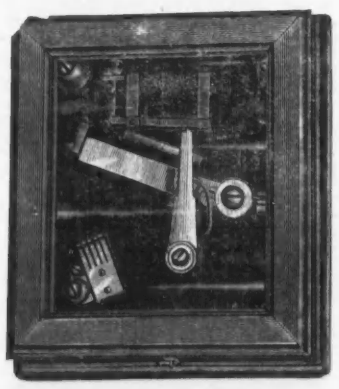


FIGS. 1 AND 2.—STATIONARY AND PORTABLE TACHOMETERS.

While the above instrument is very convenient for indicating the speed of line shafting, some apparatus for determining the speed of individual machines is equally necessary, and for this purpose the portable tachometer shown in Fig. 2 has been constructed by the same firm. This instrument does not differ in construction from that just described, but it is provided with a valuable attachment by which a large range of indications can be obtained. The dial reads up to 1,000 revolutions; but by means of a set of gear wheels, which can be quickly attached, the scale indications can be reduced one-half or increased twofold, thus making the scale read 500 or 2,000 revolutions. The total weight of the instrument, including the case, is only five pounds.

A New Protection for Armatures.

The burning of the insulation covering the wire on an armature, through any cause whatever, is a serious accident to many of the local lighting companies in the smaller towns, where the income is not sufficient to warrant the purchase of duplicate armatures or entire machines, and often necessitates shutting down the entire plant not only for that evening, but possibly for several nights until repairs can be made or a new armature obtained from the factory. Such delays cause much annoyance to consumers, to say nothing of the financial loss entailed through rebates allowed, and it is to prevent just such destructive accidents that the Electrical Supply Company, of Chicago, have caused to be devised and placed upon the market their instantaneous armature protector.



A NEW ARMATURE PROTECTOR.

As shown in the cut herewith presented, the instrument is so arranged that upon an increase of current to any determined percentage above the normal, the magnetism of the field is instantly neutralized and the machine rendered incapable of generating the least current whatsoever, thereby, the manufacturers of the device claim, absolutely protecting the armature against serious injury in case of a "short circuit" or anything that approaches thereto. The action is instantaneous, leaving no time during which the insulation in the armature may be charred or broken down. The simple return of a lever instantly replaces all parts in their normal position. Different sizes are sent out to correspond with the number of ampères employed and the number of lamps on the circuit.

Interesting Experiment with a Rotating Ball.

We are indebted to Dr. Puluj, says the London *Electrician*, for a description of some experiments which he has recently been engaged upon, and which have also formed the subject of a communication to the Academy of Vienna. Dr. Puluj takes a metallic ball and hangs it by a bi-filar suspension centrally over the pole of a vertical magnet. The ball is then twisted round so that when let go it tends to spin on its axis by the untwisting of the suspension. Dr. Puluj finds that in such a case the ball tends to rotate around the pole of the magnet in the same direction as that in which it spins on its own axis, and that the effect is independent of the direction of the polarity of the magnet. A mathematical investigation shows that this is the necessary result of the generation of Foucault currents in the rotating ball.

Large Belts for Electric Light Stations.

Now that electric light stations are attaining to such immense proportions, the power transmitting apparatus within their walls shows an equal tendency to enlargement, and the result is that the engines, shafting, pulleys and belts employed in electrical work are already among the largest of their kind, in any industry whatsoever. This feature of electrical development is strikingly brought out by the belt just made by the Charles Munson Belting Company, of Chicago, for the Minnesota Brush Company, of Minneapolis. This belt is no less than 68 inches wide, double ply, 150 feet long and is believed to be the largest belt in any electric light station in the world. It is, in fact, very little smaller than any other big belt known. The Heim Belting Company, of this city, have a 69 inch, three-ply belt running at the L. Waterbury rope works, and a 72 inch, 150 feet long, estimated weight 3,000 pounds, running at the Planet Mills of Buchanan & Lyle, Brooklyn.

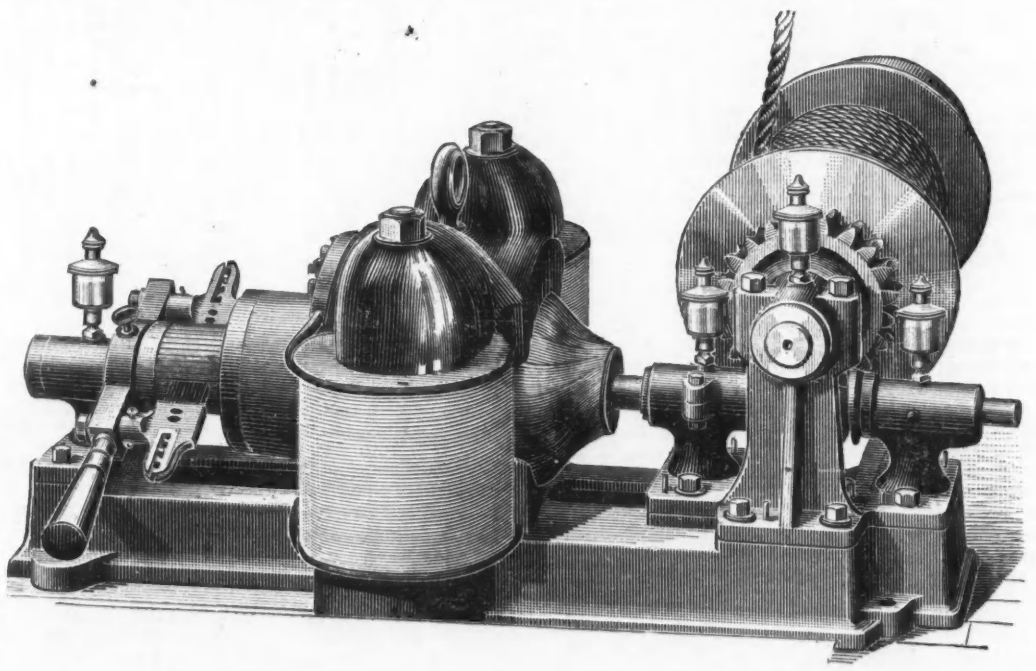
These are the largest belts on record, though there is every likelihood that pretty soon there may be a call for even larger, to be used in the generation of electric current. The merits of these large belts, as compared with smaller ones, are still hotly discussed, and the controversy is not unlike that which perennially agitates electric light conventions, as to the relative advantages of large and small engines for dynamo driving; but as large engines are greatly in vogue and favor with electrical engineers, we expect ere long to find the "biggest belt" in an electric light and power station.

An Electrical Shell Hoist for Men-of-War.

An illustration is given on this page of one of the electric hoists built by the Sprague Electric Railway and Motor Company, for the new United States crusier "Atlanta." This hoist is the first of its kind that has been built for this work, and this commencement of the use of electric power on shipboard is most novel, and promises to extend rapidly. The advantages of electric power on board vessels over the transmission of power by steam to different portions of the vessels are many, and the general adoption of incandescent lighting on shipboard enables such motors to be operated without additional dynamo installation.

The hoist which we illustrate is of 3 h. p., using the regular Sprague graphite brushes. It can be run forwards or backwards with the greatest facility by the simple movement in one direction, or another, of an electric switch. By means of this same switch the speed can be varied to any degree desired.

Although built for the special purpose of hoisting shells, this combination will serve also to meet a large demand for small hoists in manufacturing and other industries, where the small space occupied by an electric motor is quite a desideratum. There is a marked tendency toward the combination of motors with other machines, as in the above instance, and experience shows that such combinations create a demand as their advantages become recognized.



ELECTRIC MOTOR SHELL HOIST.

Measuring High Potentials.

To the Editor of The Electrical World.

SIR: In a communication published in THE ELECTRICAL WORLD in the issue of June 8, Professor Carhart, of the University of Michigan, Ann Arbor, Mich., states that the method of measuring high potentials, previously described by the writer in your paper, was not novel, having been suggested, he says, about a year ago by Mr. Lockwood, of Detroit.

I think I ought to state that while my description was published in April of the present year, the method was suggested by the writer also about a year ago, and was soon after applied to measure the potential of a large Brush constant current motor running on the circuit of the Chicago Arc Light and Power Company.

The idea, however, was so simple that it seemed as though it must have been used before, although to my knowledge nothing had previously been published, descriptive of such a test. In regard to the manner of making measurements, the writer assumed that any one employing the method would take readings in such a manner as could insure the best results in any particular test.

CHICAGO, Ill., June 7, 1889. FRANK L. PERRY.

The National Electric Light Convention at Niagara Falls.

The following important notice has been issued by Secretary Garratt:

For the accommodation of those who will attend the next convention of this association, which will be held at Niagara Falls Aug. 6, 7 and 8, a special limited vestibule Pullman train will leave Jersey City via the Lehigh Valley Railroad as the second section of the 8 A. M. limited ("Comet"), Monday morning, Aug. 5. This train will consist not only of several Pullman parlor cars, but also of dining cars and an observation or composite car, as may be hereafter decided. It will be in every respect equal, if not superior, to the famous Electric Light Special between New York and Chicago last February.

As there is no road in the Trunk Line Association between Boston and Niagara Falls, and as especially low rates have been obtained between New York and Niagara Falls, Boston delegates can travel on this train as cheaply as to go direct. Parties from New England can leave Boston via Fall River Line Sunday night at 7 o'clock, and will be transferred from the boat in New York via the Annex directly to the train at Jersey City, where they will find breakfast awaiting them.

Delegates from Washington, Baltimore and Philadelphia can connect with this train at Bethlehem at 10:40 A. M. by leaving Philadelphia (Ninth and Green street station) at 9:00 A. M. Monday, Aug. 5.

From considerable inquiry it is found that many of the members propose taking their wives or lady friends to the Niagara Falls convention, and a special car will be provided for their accommodation, and everything possible will be done to insure their comfort.

In order to insure the success of this train it will be necessary for all interested parties to correspond with this association at its headquarters, 18 Cortlandt street, New York, at the earliest possible moment.

Blanks and forms are ready for distribution and seats can be assigned immediately. Mr. A. C. Case, passenger agent of the Lehigh Valley Railroad, may be found at the association headquarters every forenoon, and he will gladly furnish all needed information, and will at once issue Pullman certificates for this train. Col. C. M. Ransom, 146 Franklin street, Boston, will issue Pullman certificates to such of the New England delegates as find it more convenient to see or correspond with him.

This train will be lighted throughout by electricity and will be the largest train ever run exclusively for electrical people.

Yours very respectfully,
ALLAN V. GARRATT, Secretary and Treasurer.

St. John, New Brunswick, Electrical Exhibition.

It was announced some time ago in these columns that an electrical exhibition was to be held at St. John, New Brunswick, this summer. The arrangements for the exhibition, which will be opened on July 22, are now completed, and they include a summer carnival of no mean pretensions. For ten days St. John will be the scene of festivity. The arrangements have been so carefully devised and elaborated that the fete bids fair to be the most successful ever held in St. John, especially as it is to celebrate an event of national importance, the opening of the Canadian Pacific Railway (Short Line) to St. John, and also the union of the cities of St. John and Portland.

Naturally electricity will play a most prominent part in the celebration, and the energetic and capable electrical committee consists of the Mayor of St. John (Chairman), Jas. F. Robertson, of Manchester, Robertson & Allison; R. B. Emerson, of Emerson & Fisher; Jas. Hunter, James Stratton, Geo. F. Calkin and A. A. Knudson, and Ira Cornwall, Secretary of the Board of Trade, is Secretary.

Mr. Knudson, who has been for some time engaged in active telephone work in New Brunswick, has been appointed to the general management of the exhibition, and he has drawn up a programme that is not only of great interest to electricians and scientific men generally, but one that will prove most attractive to the public generally. Excursion tickets will be given over all the railroads, and by water from Boston. No more delightful summer trip can be imagined than a sail along the coast of Maine into the beautiful Bay of Fundy, and there are countless points of interest along the route. The climate of St. John at this season of the year is cool and bracing. The nights and days are tempered by refreshing breezes and the mosquito and black flies are unknown. The scenery around the bay is singularly beautiful, and year by year the number of visitors to the shores of Fundy for health and pleasure is rapidly increasing. Of course the main feature of interest will be the electrical exhibition, which, even in these days of industrial and scientific displays, will be strikingly effective. It is intended to make a special point of illustrating the resources and capabilities of the electric light, and some of the effects which will be shown with the incandescent light are of marvellous beauty. It is gratifying to know that such an opportunity of bringing electrical supplies of all kinds before the public is being fully appreciated not only in Canada but in the United States, and orders for space from the most prominent electrical firms are pouring in. On the 23d of July an athletic tournament, comprising base ball, cricket, lawn tennis and lacrosse, will be held at the grounds of the Amateur Athletic Association, and at the Shamrock Grounds, Barrack Square, and St. John Lawn Tennis Court. In the afternoon there will be a monster trade procession, in which all kinds of crafts, callings and industries will be represented. The march will be ended on the exhibition grounds, where the day will be fitly closed by a gorgeous pyrotechnic display. On the morning of Wednesday there will be a regatta on the beautiful harbor of St. John, which is world renowned as the training ground of some of the finest oarsmen of modern times.

The regatta will include not only yachting and rowing matches, but the element of fun will be largely developed in canoe, saw-log, wash tub, hurry-skurry and other similar contests. In the afternoon some of the fastest horses in the Dominion will be represented in the speed trials at Moosepath Driving Park. On Wednesday evening the mammoth marine pageant and pyrotechnic display on the harbor will come off. All kinds of craft gay with lights and bunting will take part, and the marine display will be supplemented by a torchlight parade on the hills, and heightened by streams of powerful electric light of many colors from the shore.

Thursday will be commenced by a grand athletic tournament. This will be the Carnival day, the feature of which will be a carnival parade, after the manner of the Mardi Gras processions in New Orleans. In the afternoon there will be racing at Moosepath Driving Park, and additional novelties will be introduced at the electrical exhibition. There will also be a torchlight procession of the carnival parade.

Friday, the 26th, will include match games between representative baseball and cricket teams on the Amateur Athletic and Shamrock grounds and the Barrack Square, a military parade in the afternoon, and in the evening a grand display of fireworks on the exhibition grounds, the harbor, at Partridge Island, the breakwater and the heights of the west side. Saturday will be another full day, which will end with a display of fireworks on Kings Square, and a concert of instrumental and vocal music at the Exhibition Building, at which some of the finest bands and leading soloists in the country will perform.

The festivities will last for ten days. It will be seen that no trouble has been spared to provide a varied and attractive programme, and it is to be hoped that the large attendance at the exhibition which is expected will be appreciably increased by visitors from the United States, as no better summer excursion could be desired.

Further details will be found in the official announcement appearing in our advertising pages this week, accompanied by a fine view of the handsome exhibition building.

Death of Mr. W. F. Swift.

It is with the deepest regret that we record the death of Mr. W. F. Swift, the secretary of the Brush Electric Company of Cleveland, O. The following details from the Cleveland *Leader* of June 12 will be of interest to a large number of our readers:

"The death of William F. Swift, secretary of the Brush Electric Company, and a member of the board of directors, occurred yesterday morning at his home, No 194 Streator avenue. Although a young man he had had a successful career both as a newspaper man and in the business world, and the announcement of his death will be received with deep regret by a large number of friends. His death followed a long period of ill health from which, until recently, no danger was apprehended. He was a tireless worker, and the persistent energy with which he performed his duties, regardless of his health or other considerations, undermined his constitution and probably led to the development of consumption, which was the direct cause of death. Mr. Swift was born in Ravenna, on March 7, 1852. In 1867 he removed with his parents to Ashtabula, and soon afterwards began his newspaper experience by serving as correspondent of the Cleveland *Herald*. His excellent work received proper recognition in 1872, when he was given a place on the local staff of that paper. He was in a short time made city editor and soon afterward resigned to accept a situation with the Chicago *Inter-Ocean*. Six months' experience in Chicago was followed by his return to Cleveland, when he became city editor of the Sunday *Post*, and was connected also with a trade journal. He could not content himself with life on weekly journals, and resumed the city editorship of the *Herald* that he might again experience the rush and whirl of daily newspaper work. In 1880 he became city editor of the *Leader*, and less than a year later he accepted the offer of a position with the Brush Electric Company. He first traveled in the South and in Mexico, establishing electric light plants, and upon his return to Cleveland was elected secretary of the company. He spent the winter of 1887–88 in New York, establishing an Eastern office of the company, and at that time he suffered severely from throat trouble. His lungs became affected, and from March to June, 1888, he was in Texas, and after a brief stay in Cleveland following his return in June he went to Sante Fe, N. M. He returned from Santa Fe a month ago, after having received assurances from the doctors there that his lungs were all right, but it was found upon his arrival in Cleveland that he was in the last stages of consumption. Mr. Swift was married to Miss Flora M. Chichester in this city on Jan. 2, 1879 and is survived by Mrs. Swift and three children. He joined the church in Ravenna when thirteen years of age and became a member of the Euclid Avenue Congregational Church by letter when he took up his residence in the East End. The funeral will take place at 2 o'clock Friday afternoon and the remains will be placed in a vault at Lake View Cemetery."

Those who enjoyed the pleasure of Mr. Swift's acquaintance will long remember his stanch fidelity to the interests he represented, and his quiet affability and dry humor in the hours of recreation and unbending from business. His long connection with electric lighting had given him an interesting experience, and as he had followed the development of the business with an intelligent and keen perception of its possibilities, he was always a most delightful and instructive companion. His newspaper training, moreover, had quickened his appreciation of the manner in which to grapple with difficult questions, and he was not a little esteemed for his skill in the conduct of important negotiations.

The Consolidation of Electrical Interests in England.

The amalgamation mania is spreading, says our London correspondent. Last week I was able to record the completion of the negotiations resulting in the amalgation of our three largest telephone companies. The week previous all the Woodhouse & Rawson subsidiary companies were united into an "harmonious whole." This week the Electric Construction Corporation has been floated. This company will purchase the works and businesses of Elwell-Parker, of Wolverhampton, of the Electrical Power Storage Company and of the Railway Electrical Contractors, in addition to acquiring the patent rights for the United Kingdom of Sprague and Julien. The capital is to be £500,000 in £10 shares, and it will doubtless be considerably over-subscribed, as the directorate contains several influential names and the prospectus foreshadows a minimum annual dividend of 10 per cent. The operations of the Electric Construction Corporation will be of a very extensive character, embracing public and private lighting, tramway traction, railway train lighting, mines, canals, and general motive powers. I understand, however, that electric traction will form the main feature of the company's business, and it is to be hoped that the advent of this new worker in the field will infuse a little animation into this neglected branch of the electrical industry. With reference to the telephone amalgamation the Postmaster-General has just written to the United Telephone Company to say, that in the interests of the shareholders of the companies, he thinks it right to say that although the post-office does not *at present* offer an opinion as to the legality of the course adopted, the amalgamation of the licensees was *not* contemplated by the post-office when the licenses were granted. This letter, taken in conjunction with the reply of the Postmaster General to a question put to him last night in the House of Commons, seems to indicate that he is waiting for some outburst of popular indignation before he makes up his mind as to how he will deal with this nefarious scheme for providing the public with a complete system of interurban telephony.

Board of Electrical Control.

The Board met on the 13th inst. A letter was read from the Manhattan Company, which complained that in consequence of insufficient facilities it was compelled to take a devious course when laying its lines, whereas if certain subways were provided it could be saved much trouble, time and expense. It asked that subways in Twenty-eighth, Forty-ninth, Fifty-seventh, Fifty-ninth and other streets be provided immediately. An offer to go to the expense of building subways in case the Board should not be prepared to undertake their construction, was not favorably received, Commissioner Gibbens deprecating the idea of any one building subways except the Board of Electrical Control. In the course of the discussion the Mayor expressed his willingness to meet the company's views as far as possible, and stated that he did not wish to be placed in the position of forcing them under ground, when proper provision was not made for them.

Mr. Kearney, the engineer of the Board, presented a report in which the work ordered by the Board and the amount actually done was compared, and the secretary was directed to communicate with the president of the Construction Company urging the immediate completion of work in arrears. This included provision for wires for telephone and telegraph service in Fifty-eighth street, from Fifth avenue to Tenth; in Tenth street, from Sixth avenue to Eighth; in Dey street, from Church street to Greenwich; in Fourteenth street and Sixteenth street, to Union Square; in Forty-ninth street, from Fourth avenue to Madison; in Fifty-third street, from Fifth avenue to Sixth, and for crossings in Broadway and Sixth avenue at all the intersecting streets, from Thirty-sixth to Fifty-eighth street.

In regard to the question of new pavements, for which the legislature has appropriated $3,000,000, to be expended at the rate of $1,000,000 a year, the Mayor said that he objected most strongly to the idea of spending this money in laying the pavements and then having them ripped up again, and he urged the early declaration from the different companies of what accommodation they wanted, so that everything could be completed before the paving was put down. As soon as the old pavements were torn up they could have the subways constructed and then the new pavement could be laid down once for all. The matter was referred to the Commissioner of Public Works and the engineer of the Board, who will report thereon. A communication was read from Pearce & Jones. It appears that that firm has a wire in the cables of the fire department, and the question whether the firm should come into the subway as a private corporation was discussed and finally referred to the Corporation Counsel.

A permit was granted for telephone wires to St. Joseph's Hospital for Incurable Consumptives.

The United States Illuminating Company applied for a permit to erect 29 poles on East Sixty-ninth street to connect with Jones' Wood, but the Board was not disposed to grant it.

There were also a number of applications from the Brush, the Manhattan, the Harlem, the East River and other companies for permits, some of which were granted. An application of the Western Union for permission to string wires along the Elevated Railway in upper Eighth and Ninth avenues and Greenwich street was granted on it being shown that it would enable the company to remove 400 of its poles.

The question of allowing companies to replace damaged or dangerous poles with new ones whenever they considered it necessary was brought forward. The Mayor objected to it strongly as allowing too much latitude to the companies.

The matter was referred to the engineer of the Board for report.

The resignation of Assistant Secretary Lovecraft was tendered and accepted. The Board adjourned to Monday the 17th at 12 o'clock.

Electricity Before the International Medical Jurisprudence Congress.

At the meeting of the International Medical Jurisprudence Congress, held in this city lately, one or two papers were read on the bearing of electric applications to medical jurisprudence. Among them was a paper by Mr. Harold P. Brown entitled "A Medico-Legal View of Electrical Distribution." After describing the wonderful growth of electrical appliances the writer drew a picture of the future, in which he said: "The air will no longer be polluted with smoke, for one immense station, provided with triple or quadruple expansion engines and furnaces in which combustion is complete, will supply heat, light, power and motion. The consequent addition to human health, comfort and length of life by the banishment of dirt and noise will be enormous. Electrical disinfection and sewage purification are already in use, and since we can command immense volumes of electricity it is not improbable that a better understanding of the laws of meteorology will enable us to at least partially control the weather, and thus avoid the evil effects of severe changes and extreme temperatures."

Mr. Brown then gave his well-known views as to the danger of high tension currents, and as a remedy for the existing state of affairs suggested that the only safe and proper course is to have a thorough examination made by unpurchaseable medico-legal experts, and laws in accordance with their recommendations submitted and urged for passage.

Mr. J. Murray Mitchell also read a suggestive paper, entitled "Legislative Control of Dangerous Electric Currents," in which he followed much the same line of argument as Mr. Brown.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, June 17, 1889.

The Visual Synchronism Company is putting forward a system of telegraphy of which Professor Rogers is said to be the inventor. It appears to operate on the Wheatstone method, a perforated tape being used at the sending end.

The Æolian Organ and Music Company, of 831 Broadway, has an electrical piano on exhibition, driven by a C. & C. motor taking current from the arc circuit in the street. The attachments may be placed on any piano, I understand. The music rendered is excellent.

Mr. A. B. Laurence, of 1A Platt street, has been supplying all the belts for the Straight Line engines referred to in another paragraph of my notes. He is also furnishing all the belts for the New York Mutual Life building, the Mount Morris Electric Light Company's plant, the Eickemeyer plant in the new Tower building and the Loring building. It is interesting to note that Williams & Potter have bought over 600 belts from Mr. Laurence in the past three years, making nearly 6 miles of belting.

Mr. A. C. Kendall, who is well known and popular among electric light managers, has taken the management of the Daft Electric Light Company, for New Jersey, making his headquarters at Trenton. I have no doubt that a good many inquiries and orders will find their way to him, as he has generally got what he thought he ought to have in such matters. The Daft system is making rapid strides, being extensively introduced everywhere, and through Mr. Kendall's agency the State of New Jersey will not be behindhand in appreciating its great advantages.

The Babcock & Wilcox Company, through its New York manager, Mr. Pratt, reports the filling of the following orders among the electric light interests, the boilers either being erected or ready for shipment at this writing: 1,000 h. p. for the Allegheny County Electric Light Company, of Pittsburgh, Pa.; 1,000 h. p. for the East End Electric Light Company, of Pittsburgh, Pa.; 146 h. p. at the Metropolitan Telephone Building, New York; 275 h. p. for the Kansas City Electric Light Company; 832 h. p. for the Peoples' Railway, Electric Light and Power Company, St. Joseph, Mo.; 1,100 h. p. for the Royal Electric Light Company, Montreal, and 1,000 h. p. at the station of the Edison Electric and Illuminating Company, Brooklyn, N. Y.

The Safety Insulated Wire Company, of 234 West Twenty-ninth street, this city, are making an insulated wire that is seamless and without joints. I saw a large order the other day at Robertson's Lead Incasing Works, 129 Water street, Brooklyn, where it was being covered with lead for use by one of the local lighting companies in the New York conduits. The company have received orders from the Brush Illuminating Company, the Manhattan Company, the Metropolitan Telephone Company, the Bell Telephone Company and others. I understand that Mr. H. K. Thurber is the president of the company. All the manufacturing is done at the works of Cary & Moen, in West Twenty-ninth street, that concern being, it is said, largely interested. Mr. Requa is the engineer. Mr. Wm. Maver, Jr., has been testing the product and speaks highly of it.

Mr. F. H. Haywood, of Williams & Potter, is dividing his time between the palaces of Europe, with the other members of the American Society of Mechanical Engineers, and superintending the Straight Line exhibit at the Paris Exposition, where they have four engines of 100 h. p. each and one of 40 h. p. driving half the American section. These engines were selected for the purpose by Mr. T. R. Pickering, the able machinery chief attached to the United States Commission. While Mr. Haywood is studying the opportunities abroad, the firm at home are very busy. One of their recent orders was for two 45 h. p. engines for the new Sound steamer "Connecticut." They were ordered May 23 and by May 29 were set up and ready. This is said to be the quickest piece of work of the kind on record. The engines are now hard at it, and have not been touched since they started. Another order is for 135 h. p. for Ehrich's new store; 80 h. p. for the Central apartment house; 90 h. p. for the *Herald* building.

A Good Record from Atlantic City.—The road which has been running upon the Sprague system at Atlantic City, N. J., continues to be visited by a large number of street railway men from all parts of the country, and electricians and others interested in electric traction. A record of the operation of this road since the first cars were started shows that a grand total of six thousand four hundred and sixty-four separate trips have been taken by the cars in operation upon this road. During this time, and in spite of the fact that the motors used upon this road were of the new Sprague type, which had hitherto not been tried upon any road, not a single trip was lost by the electric cars. This is a record which it would be hard to duplicate in the records of any other machine used for the first time, and it is only additional evidence toward showing the superiority of the electric motor in simplicity, efficiency and durability to other types of machines, and the care with which the leading electric supply companies are building their apparatus.

Mr. C. D. Bernsee, of the Eco Magneto-Watchman's Clock Company, has recently issued a very neat pamphlet giving details as to the Eco system, as designed expressly for counting rooms, manufactories, public buildings, banks, etc., and he takes occasion to cite the language in which the Associated Factory Mutual Fire Insurance companies, of which Mr. Edward Atkinson is chairman, express their approval of the Eco clock as a means of watching the watchman. I may note, by the way, that Mr. Bernsee's company has recently brought an action at law in this city against the Cleveland Electric Manufacturing Company and J. S. Morse, on the ground that the Cleveland Company, representing the American watchman's time detector, having been annoyed by his success in introducing the Eco clock, have sought to damage him by notifying his customers that the Eco clock was an infringement, and that they were liable to be cast in damages. This course, Mr. Bernsee claims, has put him to great trouble and expense, hindering him from extending his business and interfering with that which he had secured. Mr. Bernsee puts the damage he has sustained at the sum of $10,000, and he proposes to make the delinquent company indemnify him for the loss of contracts and for the expenses, to that amount. The action is brought in the United States Circuit Court.

The National Conduit Manufacturing Company, 18 Cortlandt street, James P. McQuade, manager, are meeting with just such success as I always predicted for them as being their due. The practicability of their system is shown by the fact that 300,000 feet of the conduit has been underground in New York for upwards of two years, and that not a word derogatory to it has been said. The conduit is a sheet iron pipe, which has a lining of composition of cement, presenting a smooth, even surface in the interior, and it does not attract moisture, but repels it. It does not sweat like iron pipe, and I have known cases where it has been in use underground for years, and has been brought out solid, clean and free from damp. The conduit is made in any size desired, the standard being 3 inches as in use in this city. The company are now laying 200,000 feet in this city; and on the 10th inst. Mr. McQuade received word from Chicago that his contract had been accepted for nearly 200,000 feet of 3-inch conduit for the city of Chicago. The New York Police Department has recently called for 8,000 feet of 3-inch, and 50,000 feet are now being laid in the city of Boston; the company also have an order from the Phœnix Construction Company, calling for a large quantity of 4-inch conduit. This will be the first conduit of this size placed underground in any city in the Union.

Charles A. Schieren & Co., it is well known, have recently put on the market an "Electric" perforated belt, the perforations in the belt being intended to prevent air cushion. They have now issued a unique circular in which the pages are perforated in the same way as the belt, so that the reader is not only able to go behind the record, but can see through it and satisfy himself on the evidence of numerous disinterested parties that the belt is all that is claimed for it. Among these testimonials I may mention those from the Danville, N. Y., Electric Light Company, the Ann Arbor Electric Company, the City Gas Light Company, of Norfolk, Va., the Newton & Watertown Gas Light Company, Mass., and the Jenney Electric Company of Indianapolis. Mr. Armstrong, the superintendent of the Ann Arbor Company, states that the perforations are a decided feature in preventing air cushion where they formerly had much trouble with hot journals on the machine, there now being no bother on account of running, although there is much smaller tension on the belt, and this is due entirely to its being perforated. The Danville Company recommend the perforated belt to any one whose machine is running at high speed. Their belt travels over a mile a minute, and where ordinary leather was continually giving them trouble from slipping and from irregularity when the load on the dynamo was light, they are now not in the least inconvenienced.

Messrs. Culbert Bros., of 311 West Fortieth street, have secured the services of Mr. S. H. Hoggson, manufacturing electrician of Bridgeport, Conn. While traveling on business for THE ELECTRICAL WORLD through Connecticut some years ago, I had the pleasure of making Mr. Hoggson's acquaintance, and found him a capable and ambitious man, doing an excellent business in all kinds of electrical specialties, in which his inventive skill found full play. Messrs. Culbert Bros. have occupied the large five-story brick building just west of Eighth avenue for a number of years, manufacturing a full line of household hardware, and when the demand for electrical house furnishing attained its recent great proportions, the firm began to make a fine line of goods in that department. From that beginning a large trade has sprung up, and the firm are prepared to meet it. The demand seems to run now for complete household hardware in the electrical and mechanical line included in one bid, and it is also very often required that the construction work shall also be undertaken. This the firm propose to give their special attention to, and they have already quite a force of men engaged on electrical construction work. Mr. Hoggson will take full charge of this department, and he is also engaged in bringing out a complete line of electrical supplies of all kinds—door openers, letter boxes, carbon and zinc, and porous cup batteries, window springs, burglar alarms, annunciators, etc. He has developed a number of valuable ideas in this direction, and the firm expect when ready to have as complete a line as there is to be found in this country.

The Edison United Manufacturing Company report the following plants sold during May:

Purchaser.	Location.	Business.	Lamp capacity.
Roanoke E. Lt. Co..	Roanoke, Va.....	Central Station...	1,000
American Glucose Co.....	Buffalo, N. Y.....	Glucose Works...	1,000
Hackensack E. Lt. & P. Co.....	Hackensack, N. J.	Central Station..	650
Union Iron Works.	San Francisco, Cal.	Str. "San Francisco".....	1,200
Glouc'ter Ferry Co.	Philadelphia, Pa..	Str. "Sylvan Glen"	75
Estey Organ Co....	Brattleboro, Vt...	Organs.....	20
J. A. & G. A. Stevens.....	Lake Placid, N. Y.	Hotel.....	225
Bluffton Land, Ore & Furnace Co....	Bluffton, Ala.....	Foundry.....	115
U. S. Government..	West Point, N. Y.	Military Acad'my	75
Capital C'y Oil Mill	Baton Rouge, La..	Oil Mill.....	115
Silver Plate Cutlery Co.....	Birmingham, Ct..	Silver Plate Ware	40
Portland Hotel Co..	Portland, Ore.....	Hotel.....	1,750
Krehl, Hauser & Co	Girard, O.....	Tannery.....	40
Jos. Turner & Sons Mfg. Co.....	Cleveland, O.....	Woollen Mill	400
Sand Hill Hotel Co.	Augusta, Ga.....	Hotel.....	Inc. 200
R. R. Woods.....	McCook, Neb.....	Central Station...	450
Phœnix Wool. Mill	Stafford, Conn....	Woollen Mill.....	75
E. G. Acheson.....	Pittsburgh, Pa....	Laboratory.....	10
Central R. R. N. J..	Jersey City, N. J..	Str. "Sandy Hook"	225
N. Y. C. & H. R. R. R	New York, N. Y..	Railroad Depot...	1,400
Brooklyn Annex Co	Brooklyn, N. Y....	Str. "Butterfield"	75
John Schuette.....	Manitowoc, Wis...	Central Station...	1,800
Menominee E. L. Co	Menominee, Mich.	Central Station ..	75
Glouc'ter Ferry Co.	Philadelphia, Pa..	Str. "Sylvan Dell"	75
Woburn E. Lt. Co..	Woburn, Mass....	Central Station..	Inc. 300
Union Depot..... .	Ogden, Utah.....	R. R. Depot.....	Inc. 150
Elgin Watch Co....	Elgin, Ill.....	Watch Factory...	5,000
Penn. R. R. Co.	Altoona, Pa.....	Shops.....	225
Wm. Rockefeller...	Tarrytown, N. Y..	Residence.....	750
Clifton Mfg. Co.....	Clifton, S. C.....	Mill.....	750
			18,265

Mr. Ralph L. Shainwald, president and general manager of the P. & B. electrical compounds, exhibited to me last week some specimens of the latest improved P. & B. insulated wires manufactured and controlled by the Electrical Supply Company, of Ansonia, 171 Randolph street, Chicago, and 33 Church street, New York. These specimens were cut off an ordinary reel of wire. The bare wire is heavily braided and saturated with the P. & B. compound, which forms a perfect insulator, tough, but flexible. The Ansonia people tested this compound for over one year before adopting it. It is not generally known that Mr. Shainwald makes insulating sheets of paper. This material consists of tough brown paper, specially made and thoroughly saturated with P. & B., after which it becomes pliable but very tough, and can be used for all electrical purposes. Its greatest sales are among refrigerator manufacturers, especially for refrigerator cars. It is tacked inside the car, or the inside of the car is sheathed with this P. & B. paper. It takes the place of charcoal and tin lining, keeps the cars cool, costs immensely less to introduce, and is said to be equal, if not superior, to any other system in vogue. Mr. Shainwold showed me orders amounting to nearly $20,000 the past week, received by telegraph from the largest companies making these cars, I do not see why this insulating paper is not applicable to every kind of electrical use where thin sheets of material are required.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, June 15, 1889.

Mr. Eugene Phillips, of Providence, was in town this week.

Mr. O. E. Madden, of the Empire City Electric Company, was in the city this week.

Gen. A. K. Stiles, of the Van Depoele Electric Light Company, Chicago, is staying at Young's Hotel.

Overhead Lines and Poles.—The Mayor has vetoed the order which was granted the Boston Electric Light Company.

Plymouth, Mass.—This city is being equipped with telephones furnished by the Pulsion Telephone Company, of this city, and the people express themselves well satisfied with the result.

American Bell Telephone Company.—The directors have declared a regular dividend of 3 per cent, and an extra of 6 per cent., both payable July 15 to stockholders of record June 29.

Western Union Telegraph Company.—A loose wire lying on the street has cost the Western Union Telegraph Company $500 for pulling a man from a wagon and throwing him on the street. Five hundred dollars worth of surveillance of lines would be better expended.

Mr. W. J. Fraser, of the Direct Cable Company, Rye Beach, was a welcome visitor at this office this week. Mr. Fraser spends most of his time at Rye, but manages to get to Boston about once a week. This torpid weather makes one envy his position on the beach, though in the winter it is to be feared his lot is not such a happy one.

The Massachusetts State Legislature has at last adjourned, and we will hear no more of elevated railroad bills for some time. We may expect an early assault on electrical matters in the next Legislature, and I would suggest that each representative and Senator utilize part of his vacation by becoming better posted on things electrical by visiting some of the large electric factories through the country.

Brockton, Mass.—The citizens of Brockton apparently have not been well satisfied with their telephone service, and have lately applied to the Pulsion Telephone Company, of this city, to help them out. Before long it is anticipated that the city will be fully equipped with an acoustic telephone, and the citizens are congratulating themselves that lower rates may be expected.

Telephonic Communication with Life-Saving Stations.—A large number of captains and the directors of the Chamber of Commerce have signed a petition to be forwarded to Hon. S. I. Kimball, General Superintendent United States Life-Saving Service, in order to have better telephonic connection between the life-saving stations along the coast. Monomoy and Chatham will probably be the two first stations connected.

Paine & Francis have closed a contract for an Edison plant for the Auchmudie building, this city. The building will be wired for 900 lights, but the dynamo capacity at present will be 700 to 800 lights. The contract includes engines, boilers, wiring and all the various electrical details. This building adjoins the Ames building, at present being fitted with an electric light plant by the same firm. The New England Wiring and Construction Company will do the wiring.

Pettingell, Andrews & Co. continue to enjoy the patronage of large numbers of purchasers of electric apparatus both in the New England States and in the West. Mr. Pettingell is an extremely busy man, and does not spend many moments away from business, but in a short lull to-day he told me that the prospects of his firm were exceptionally bright at present, and that he had estimates out for very large contracts which he had every hope would materialize very soon.

Middleboro, Mass.—The dispute between the Middleboro Electric Light and Power Company and the Middleboro Gas and Electric Company, remains in "statu quo." Meantime the Middleboro Gas and Electric Company are furnishing electric light on the Westinghouse system, and the Electric Light and Power Company are completing their station, though stopped on their pole work. The decision of the State Gas Commissioners is looked forward to with interest.

Boston City Hospital.—Electric light is valuable everywhere, and it is a matter of no wonder that the trustees of the city hospital of this city should be applying to the Board of Aldermen for permission to use the electric light. In a building of this kind, where fresh air is so necessary, the electric light becomes doubly valuable, from its valuable properties of consuming no oxygen, nor vitiating the atmosphere by giving off fumes which are dangerous to health at all times.

Sun Electric Company.—Among the many onerous duties of Mr. Frank Ridlon, none can have given him greater pleasure of late than the issuing of a circular, notifying the stockholders of the Sun Electric Company that a dividend of $1.75 per share had been declared from the proceeds of the sale of all its property. Mr. Ridlon ought to feel gratified at the result of his work, as it is largely owing to his indefatigable efforts that such a satisfactory result has been arrived at. This is probably the last we shall ever hear of the Sun Electric Company, though another small dividend may be paid shortly.

The Thomson-Houston Electric Company.—The stockholders of the Thomson-Houston Electric Company have received a circular giving a plan for issuing seven per cent. preferred stock to the amount of $1,000,000. Stock is offered at par ($25) to stockholders of record of June 20, one share to every three held. Those holding less than three shares common stock can obtain rights to subscribe on the basis of $27.50 per share of new stock for 86 1-8 c. Rights to stockholders cease on June 26, but rights for preferred stock will be for sale probably at 83½c.

Portsmouth.—The Electric Light Company are preparing to move into their new quarters, which they have been getting ready for some time. They will now have a dynamo and engine room 48 feet × 50 feet, and the boiler house will be large enough to contain three 66 inch × 16 feet boilers. The switch-board is large enough to hold the lightning arresters and controllers, and special attention is being given to make it fireproof. One 1,000-light and one 500-light Thomson-Houston alternating dynamos, and four 30-light arc machines are being installed at present, but there is plenty of room for the expected growth of the business.

F. R. Chapman & Co.—This enterprising firm, which has gone into the business of furnishing coal in large quantities to the electric light stations, appears to be enjoying great success. The Irvona coal is meeting with favor from many electric light engineers, and is in great demand, being considered superior to any other bituminous coal for steam purposes, the tests showing from 15 to 20 per cent. more steam for the same amount of coal. This company control the entire product of the Irvona mines for New York State and New England. It is remarkably free from clinker low in ash, and produces less smoke than other bituminous coals good proof of which is that hotels and apartment houses are

using it largely. Sample car loads can be procured, and all interested should give it a trial.

Newport, R. I.—A recent dispatch from Newport says: "The papers for the transfer of the property of the Weston Electric Light Company to the Edison Company has been signed, and immediately orders were given by the Edison people to put out the fires under the boilers, and a gang of men was at once put to work removing the wires. The parties who have been supplied with light by this company were notified that there would be no light for them, and consequently some had to shut up while others burned lamps, a few having gas. Numerous threats of law suits have been made, and some have already consulted their lawyers."

Crosby Steam Gauge and Valve Company.—In one office at least in Boston there is no appearance of dull times, as Mr. Pirrie, of the Crosby Steam Gauge Company, told me that their orders could only be numbered by "legion." Large orders for indicators are coming in by every mail for the English Navy and German Technical Schools, while the dockyards at Stockholm and all the European navies are using them very extensively. The Crosby indicator is, it is claimed, the only indicator which will take correct cards at very high speeds. Their sight-feed lubricators for high speed engines are also largely used, and Brotherhood uses them exclusively both in London and at the Chester Foundry & Machine Company, Chester, Pa.

West End Street Railroad Company.—There has never been greater excitement in electric railroad business than there is at present in Boston. An enormous contract will be given out in the immediate future for covering nearly the whole of the city with electric railroads. It is rumored that the Thomson-Houston Electric Company have been successful, but no definite information can yet be given. Meantime the West End Company are pushing the construction of their overhead lines on Boylston street, and, under the able supervision of Mr. McQuesten, are setting fifty poles a day. The Bentley-Knight Company are supplying 18 new motors and trucks for this branch. The contact wire will hereafter be No. 1 Brown & Sharpe gauge silicon bronze, instead of No. 6 as used heretofore, and the work is being carried out in the most substantial manner.

Fall River Line Steamer "Puritan."—This magnificent ship, which is lighted throughout by the incandescent electric light, proceeded on its trial trip last week with a large number of representative people on board. This vessel is probably the most thoroughly electrically equipped steamer afloat, having four Edison dynamos capable of maintaining 1,850 lights, furnished by the Edison United Manufacturing Company, of New York. A complete electric fire-alarm system has also been installed by the American Fire Alarm Company of Boston. The lighting presents many new features and Bergmann & Co. may be congratulated upon the beautiful effect of their tastefully constructed chandeliers. No doubt the "Puritan" will carry many of the electrical fraternity between Fall River and New York this summer, as she is well worthy of a visit.

Providence, R. I.—A special dispatch of June 5 says: The new dynamo house of the Narragansett Electric Lighting Company is nearly completed. It is 200 feet long and 60 feet wide and when equipped will have a capacity of 80 dynamos of 50-light power each. It will be practically fire-proof, and will have an iron truss roof, built by the Berlin Iron Bridge Company. The boiler house at present is 78 by 62 feet, but it is to be extended as business increases until it expands to 200 by 73 feet. Eight boilers are being set, and with the engines they will be capable of developing 4,000 horse power. The surface condenser will be nine feet long, six feet wide and eight feet high. In it are 1,248 tubes three-fourths of an inch in size which are placed in an equal number of tubes 1¼ inches in diameter. This condenser is capable of condensing the exhaust steam from engines aggregating 2,000-horse power.

The Thomson-Houston Electric Company report the following sales: Narragansett Pier, R. I., 30 arc, 1,000 inc.; Seattle, W. T., 50 arc; Brockport, N. Y., 20 arc; Troy, O., 50 arc; Somerville, Mass., 100 arc; Binghamton, N. Y., 150 arc; Philadelphia, Pa., 100 arc; Lowell, Mass,, 50 arc; Boston, Mass., 1,000 alt.; Springfield, Mass., 90 arc; Minneapolis Minn., 150 arc, 1,200 inc; Rochester, N Y., 50 arc; Chelsea, Mass, 100 arc; Norwich, Conn., 400 inc.; Goldsboro, N. J., 45 arc, 600 inc.; Sorrento, Me., 30 arc. And the following isolated plants: Wamsutta Mills, New Bedford, Mass., 400 inc.; Bennett Manufacturing Company, New Bedford. Mass., 600 inc.; Whittle & Hanrahan, Providence. R. I., 15 arc; H. Ricker & Sons, Poland Springs, Me., 12 arc; Jewell Milling Company, Brooklyn, N. Y., 300 inc.; M. W. Hyer, N. Y., 50 inc.; Lawrence Line Company, Lawrence, Mass., 50 inc.; Riverside Mills, Providence, R. I., 25 inc.

Yachting Trip.—A party of gentlemen, representing various electrical industries, had a most enjoyable trip down the bay last Saturday, extending till Monday morning, on the schooner yacht "Bonita." The party was composed of the following gentlemen: Messrs. Frank Ridlon, Magee, Fred. Pettingell, Walter Pettingell, Alex. P. Wright, McQuesten, Manson, Stowe, two gentlemen not electrically inclined, and myself. Though the weather was not very propitious at the outstart, yet the gentlemen showed that they were entirely oblivious to the fact and had a sufficient fund of amusement in themselves to counteract the bad effect of the weather. It was originally intended to anchor off Marblehead for the night, but wind failing, and Mr. Ridlon not being prepared to furnish second-hand Baxter motors at such short notice, there was nothing better to do than anchor in the inner bay. Here it was that Mr. Wright, who acted throughout as commissary, had the first opportunity of showing us that he was an excellent caterer to the physical appetite of man as well as to the appetite of cities for electric light and power. Here also Mr. Magee proved conclusively that though engaged all day in disposing of isolated plants, he was not at all disposed to plant himself in isolated quarters at night. Mr. Pettingell showed clearly that in the matter of handling porcelains and *glasses* he was as great an adept in a social way during the evening as in a business way during the day. A considerable portion of the following morning was given to fishing, and the way in which Mr. Stowe pulled in the fish suggested the advisability of supplying ourselves with Sprague motors on future trips. On several of the small barren islands passed in the bay it was unanimously resolved that Mr. McQuesten should have a contract for planting the poles, and naturally Mr. Manson, in his usual generous manner, offered to supply all the Okonite wire that was necessary. On the return trip it was unanimously agreed that such trips should be of frequent occurrence during the summer, and a desire was expressed by several of the gentlemen on board that more of our New York and other friends should be present on the next occasion. A. C. S.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, June 15, 1889.

Peoria, Ill., is ready to expend $1,200,000 on water-works and electric railways report says.

The Chicago Edison Company are installing an additional 200 h. p. "Ideal" engine and are running full capacity.

The Town of Lake Arc Light Company, of Chicago, has been formed by E. D. Petrie, A. R. Cottle and E. S. Metcalf, with a capital stock of $50,000.

The Electrical Publishing Company, of Chicago, has been formed by F. B. Uhrig, J. Walsh and M. B. Austin, with a capital stock of $50,000.

Leonard & Izard have secured the contract for installing the 500 light Thomson-Houston incandescent plant in the Plies & Heck Hotel at Milwaukee, Wis.

Capt. James D. Randall, of the Novelty Electric Company, Memphis, Tenn., is looking up the question of storage cells preparatory to installing some plants.

The American Electric Meter Company, 327 Rookery building, Chicago, will have their new patent meter for direct currents on the market next week.

J. R. Burdick, receiver of the Callender Waterproof and Insulating Company, was in town for a day or two this week closing up the affairs of the company.

The Jeffrey Manufacturing Company, Columbus, Ohio, contemplate purchasing several small dynamos early during the summer and are securing prices.

The Illinois Anglo-American Storage Battery Company, Chicago, have secured a large sized order for their cells from the Pullman Palace Car Company.

The Minnesota Phonograph Company, at Minneapolis, are employing Elect ical Accumulator cells for operating the motors attached to their instruments.

F. M. Shaw, land agent Missouri Pacific Railway, with headquarters at Baxter Springs, Kan., is looking up the question of electric lights for several towns along the line of his road.

W. Whitney Munroe, formerly Western manager of the Baxter Motor Company, now has special territory in the East which which he is working in behalf of the C. & C. Motor Company.

The Sperry Electric Co. have recently shipped several complete barge lighting plants to Duluth, Minn. They have fitted up a handsome new office at the factory, and doubled their clerical force.

Hyde Park, Ill.—The board of trustees have advertised for proposals for lighting the streets of the village "either by gas, electricity or otherwise." The gas company has the contract at present.

Professor Barrett, city electrician, and Fire Chief Swenie, started East on Saturday last to inspect the methods used in lighting several Eastern cities. They will be joined in New York by Mayor Cregier.

The Phœnix Incandescent Lamp Co. have received so many orders during the past month that their working force has been doubled. They make a specialty of manufacturing lamps to order for any system.

St. Paul, Minn., will shortly have three new buildings in process of erection requiring electric light plants, namely, the office building of the St. P., M. & O. Ry. Co., Noyes Bros. & Cutter drug house and Masonic Hall.

The Fort Wayne Jenney Electric Light Company entered a bill in chancery, a press dispatch states, at Indianapolis, June 8, against the Evansville Gas and Electric Light Company, operating the Westinghouse system.

The Walworth & Lawton Manufacturing Company, of South Bend, Ind., propose removing to Bay City, Mich., where they can more easily secure the superior quality of timber used in cross arms, house blocks, etc., they manufacture.

Denver, Col., will soon have two new electric railways, the Thomson-Houston Electric Company having secured the contract for a three and a half miles road on Alameda avenue, while the Sprague system will be installed in South Denver.

W. R. Rathvon, Western agent at Denver, Col., for the Hawkeye Manufacturing Company, is interested in the subject of electric light carbons and proposes establishing a factory in the West. He is now looking up the cost of machinery.

The Thompson Interlocking Vestibule Car Company has been formed here to manufacture, sell and operate vestibule and other railway cars; capital stock $10,000,000; incorporators, Thomas E. Thompson, C. H. Jones, H. H. Scoville and D. P. Cory.

Geo. Westinghouse, the big-hearted millionaire of Pittsburgh, is reported to have given $15,000 to the Johnstown sufferers. What single individual has given more? He has also taken a personal interest in the removal of the wreckage at the railway bridge below Johnstown.

The Van Depoele Electric Manufacturing Company, of Chicago, are placing lighting plants on the following excursion steamers plying in and about Chicago: Steamer "Chief-Justice Waite," 10 arc lights; "John A. Dix," 150 incandescent lights; "Gordon," 100 incandescent lights.

The Mather Incandescent Plant in the new and magnificent hotel, the Spaulding House, at Duluth, Minn.. is in full operation, all the lights having been turned on by the manager, J. H. Reid, on the 6th inst. Two Mather dynamos, each of 400 lights capacity, operated by a Williams engine of 100 horse-power, furnish the required current.

The Minneapolis Edison Company are again pushing their work along with the utmost speed, having had a large working force sent on from New York the moment the city injunction was dissolved. All material required is on hand, having been supplied by Leonard & Izard, and the dynamos and machinery will be placed in position as soon as the station is completed.

Smoke Consumers.—The committee appointed by the Mayor to thoroughly investigate the smoke nuisance have reported that where the flues are properly built good results are obtained with or without a smoke burner, if the fireman and engineer are only careful. The furnaces of the Chicago Arc Light and Power Company, Kinsley's, and others were found satisfactory.

Force Bain is building a 20 h. p. "locomotive;" four 15 h. p. motors for mining machinery; some fire alarm indicators; a number of automatic machines to be placed in a telegraph circuit and so arranged that they respond only to certain combinations of dots and dashes; a new system of automatic telegraph; a set of patent frictionless journal bearings for use on Pullman cars, and a large variety of other work.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations upon telephone stocks as follows:

Chicago	$305@$315	Cumberland	$69@ $70
Central Union	54@ 55	Wisconsin	115@ 117
Michigan	83@ 84	Bell of Missouri	151@ 153
Great Southern	31@ 33	Iowa Union	23@ 25
Colorado	38@ 40	Missouri and Kansas	63@ 65
Rocky Mountain Bell	41@ 42		

The Central Electric Company, Chicago, are shipping large quantities of Okonite wire each week. They filled one order for 60,000 feet this week, and last week shipped complete, same day order was received, the entire construction material for a twenty mile electric light circuit. In coiling wire they use an ingenious measuring device for registering actual number of feet transferred from one coil or reel to another. This machine does away with all possibility of injuring the insulation or twisting or bending the copper.

Charles Henry Wilmerding and Miss Lily Valeria Fay were united in marriage in St. James' Protestant Episcopal Church, Chicago, Wednesday evening, June 12, by Rev. Dr. Vibbert, rector of the church. Following the ceremony an elaborate wedding dinner was served at the residence of Mr. Charles Norman Fay, No. 43 Bellevue place, at which about 60 guests were present. After a brief wedding journey, Mr. and Mrs. Wilmerding will reside in Evanston. Mr. Wilmerding is the genial secretary, treasurer and superintendent of the Chicago Arc Light and Power Company, and has the best wishes of all the electrical fraternity.

St. Louis News.—There is some talk of an electric railway across the Eads bridge, St. Louis, to replace the omnibus line that is running at present. If a franchise can be obtained from the city of East St. Louis, Ill., so that the cars can be run from the east approach to the centre of the town, it is quite probable that it will be built. The Newstead avenue Elevated Electric Railway filed its bond with the city register on the last day of grace, thus securing its franchise, but it is probable that there will be no work done for several months. The Pond Engineering Company, through their Omaha representative, have lately sold to Mr. R. R. Woods, of McCook, Neb., an 80 h. p. steam plant, consisting of boiler, Armington & Sims engine, boiler feed pump, and heater to run an electric light station.

Council Bluffs.—The Electric Light Company have just put in a large incandescent plant. The construction was done by the Western Engineering Company, of Kearney, Neb., who have just withdrawn their men upon the completion of their work. The Council Bluffs' electric railway plant has also just been increased quite largely. There is the Thomson-Houston system, and the Omaha Motor Railway have their men upon construction, preparing their road for a similar equipment. The Omaha Street Railway Company has lately given a contract for twenty motor cars of 30 h. p. each, and five miles of double track electric equipment. The city was full of electric railway agents. The contract was finally carried off by the Sprague Company, through their agent, the Western Engineering Company. In other electrical lines Omaha is rather dull. The reorganization of the Midland Electric Company has lately taken place, but in electric lighting nothing is being done, except the installation of one or two small Edison plants by the West ern Engineering Company.

St. Joseph, Mo.—The electrical activity now to be seen in St. Joseph is astonishing to the uninitiated. Not less than the three prominent construction companies are pushing work on the various electric railway, power and light plants. The Western Engineering Company, of Kearney, Neb., has its men at work on the construction of an extension of the Wyatt Park Electric Railway, and also has a large gang of men working on the construction of the People's Railway, the new Sprague road. It will be remembered that three roads, all in the city, are equipped with the Sprague electric system. Leonard & Izard, of Chicago, are just finishing up the construction of an other extension of the Wyatt Park Street Railway. With the extensions built by Leonard & Izard and the Western Engineering Company, together with the original line, the Wyatt Park Road has become one of quite considerable trackage. The stations for the new Sprague power and Westinghouse incandescent plant is going up rapidly. The inside wiring for the latter plant is being done by the Keystone Construction Company, of Pittsburgh, Pa., and the pole-line work by Mr. Yenowine, the manager of the St. Joseph Telephone Exchange.

The Daft Road at Cincinnati.—At Cincinnati the new line of electric cars, recently installed by the Daft Company, runs for a short distance over the Gilbert avenue cable line. Just in front of the power house, the cable, which is in two divisions, ends, and for a short distance the trains of two cars passing this point have to release their grip from one cable and travel by momentum alone until they take hold upon the other. As it frequently happens that the momentum of the train is not sufficient to carry it across, a winding drum with a cable attached has been placed at the point of division and is used to bridge the gap. Recently, a car was sent out with a new grip, which was a little too large, and upon arriving at the point referred to, the grip jammed in the slot. The winding cable was attached and the drum started, but the car did not move. While it was preparing for another trial, one of the Daft electric cars came along, and with no very apparent effort, pushed the cable car in front of it until it could take hold upon the cable. This was done on a slippery track, and is a very clear demonstration of the case with which the electric motor encounters difficulties, and the large reserve force, so useful in emergencies, which it possesses.

Salt Lake City, writes a correspondent, has followed the wake of its numerous Western sisters, and is to have an electric railway on the Sprague system. The railway company is not sparing expense to make a model road, and their location gives them an advantage in speed not enjoyed by many other street railways. The streets of Salt Lake are very wide and the railway tracks are in the centre. The poles will be between the tracks. A wide roadway is left on either side, and the running of the street cars is very little interfered with by ordinary street traffic, even on the busiest streets. The construction of the electrical equipment was contracted for by the Western Engineering Company, of Kearney, Neb. This company sub-let the labor to Mr. R. M. Jones, of Salt Lake. Mr. Jones is agent for the Sprague and Edison companies in Utah and Wyoming, and has constructed several Edison electric light plants. In each case his stations have been models of beauty and convenience. It is naturally expected that the Salt Lake railway plant will have a station above the average in appearance and ease of handling. Utah does not seem to be a very fertile territory for the ubiquitous electric light agent to work. There have been very few plants put in lately. Amongst them is a central station (Edison) at Park City, put in by Mr. Jones, and an Edison isolated plant in the Union Pacific railway station at Ogden, also put in by Mr. Jones. Other lines of electrical business do not seem to be much more flourishing. D.

THE TELEGRAPH.

A New Cable is proposed, it is said, from Ostend, Belgium, to Portland, Me., to be built by German capital.

Bucket Shops. Gov. Hill, of this State, has signed the bill directed against bucket shops. The proprietors of the shops are, as a body, greatly disgusted, but some of them say that they don't mind.

Western Union Earnings.—The Western Union Telegraph Company has estimated earnings of $1,450,000 for the March quarter, or nearly $100,000 more than the corresponding period last year. A dividend of 1¼ per cent. has been declared. Owing to the

large surplus, it is thought, however, that Western Union ought to be paying 6 per cent annually.

The Train Dispatchers' Association in convention at Indianapolis completed its business and adjourned on June 14. A. A. Zion, of that city, was re-elected president, and J. F. Branton, of Willmer, Minn., vice-president. E. J. Peabody holds over in the two-year office of secretary. The executive committee elected comprises W. H. Graves, of Winona, Minn.; W. W. Polk, Water Valley, Miss.; George B. Fairbanks, Tulare, Cal., and John Reilly, Smith Falls, Ontario.

A Hawaiian Cable.—A special despatch from San Francisco of June 15 says: F. Waterhouse, who arrived to-day from Honolulu, represents a recently organized syndicate of both American and English capital, which proposes to anticipate the movements of the Canadian Government to lay a cable from Honolulu to Vancouver or Sydney, by laying one from Honolulu to this port. The Canadian Government has had agents at Honolulu for several months trying to create some enthusiasm over the proposed cable, but they were not very successful, The Hawaiian Government favored the American proposition, and has at last found capitalists who are willing to lay the cable. Mr. Waterhouse is here to confer with parties interested in the scheme. The estimated total cost of laying the cable is that it will not exceed $1,500,000, of which from $300,000 to $500,000 can be raised in the islands.

A Canadian Cable.—A special dispatch from Ottawa of June 15 says: The idea of constructing a cable from the mainland near Halifax to Sable Island has been abandoned by the government, for the present, at least. An English company had agreed to lay the cable and work it for an annual subsidy of $10,000 per annum for twelve years, and although the amount was put in the estimates last session, nothing further will be done in the matter this year. The government received word from England to-day that nearly all the stock for the new Atlantic cable, to run from the Straits of Belle Isle to the west coast of Ireland, has been subscribed, and the government are backing this new enterprise, the capital stock of which is placed at $2,000,000, that Canada may be independent of lines now in operation. The government land line will be completed along the north shore of the St. Lawrence to join with the cable at Belle Isle, and will be handed over to the new company as a subsidy.

THE TELEPHONE.

Erie Directors.—At the annual meeting of the stockholders of the Erie Telegraph and Telephone Company, held on June 11, the following board of directors was elected: Levi Sprague, Charles J. Glidden, Charles E. Adams. Francis Jewett, A. C. Russell, J. W. C. Pickering, Abner S. Adams, Wesley A. Gove, James A. Weston, H. A. Whiting and W. J. McKinnie. Mr. Adams succeeds Mr. J. W. Bennett.

New Brunswick Telephone Company.—At the annual meeting of stockholders of the New Brunswick Telephone Company held recently at the Royal Hotel, St. John, N. B., the following office bearers were elected: Hon. A. G. Blair, president; J. L. Black, M. P. P., vice president; C. D. Jones, secretary; Hon. F. P. Thompson, managing director; directors: C. F. Sise, W. J. Robinson, A. A. Stockton and C. A. Stockton.

Important Telegraph Decision.—A decision was rendered by Judge Tuley on June 8, at Chicago, which vitally interests 2,000 stockholders of the defunct Great Western Telegraph Company, scattered about in nearly all the Western States. In effect it gives them the opportunity to show themselves not liable for the fictitious indebtedness of the company, by enjoining the receiver, E. R. Bowen, from collecting the assessment of thirty-five per cent. on stock subscriptions of nearly $3,000,000. Among the stockholders winning the victory is Senator Farwell.

THE ELECTRIC LIGHT.

Bunker Hill, W. Va., is to have an electric light plant.

Sumter, S. C.—A local electric light company is being formed by Mr. Auld.

Louisville, Ky.—The Eclipse Woolen Mills will put in a Thomson-Houston plant.

Watertown, Wis.—Mr. J. Terbrueggen has received an electric light franchise.

Hutchinson, Kan.—Mr. R. R. Price has a 25 years' franchise for electric lighting.

Florence, S. C.—The Florence Electric Light and Power Company is now organized.

Jackson, Tenn.—The Citizens' Gas Light Company will enlarge their electric light plant.

Cordele, Ga.—A local electric light company has been organized by Mr. S. J. Sibley, of Marietta, and will put in a plant.

Sauk Centre, Minn.—The Acme Electric Company has a franchise for light, heat and power. The city will take 10 arcs.

Lakeside, Minn —The Lakeside Electric Light & Power Company has been formed by E. Brown, J. E. Marvin and W. Van Brunt.

Provo, Utah Valley.—The Provo Edison Electric Light Company has been formed by S. S. Jones, T. E. Daniels and others with a capital stock of $10,000.

Tonawanda, N. Y.—The Tonawanda Electric Light & Power Company has been formed by J. N. Hinkey, A. G. Kent and A. C. Campbell with a capital stock of $1,000.

Newark, N. Y., has made a five year contract with Moffett, Hodgkiss & Clarke of Watertown for 40 arcs of 2,000 c. p., to burn 26 nights per month, at $2,400 per year.

Elizabeth City, N. C.—Mr. C. Guirkin, Jr., writes us that he is forming a company to put in the proposed electric light plant, and that in all likelihood they will adopt the Van Depoele system.

Portchester, N. Y.—The Board of Trustees of the village of Portchester have unanimously decided to have the streets lighted by electric lamps and have instructed the Committee on Street Lights to enter into a contract with the Citizens' Gas Company, who were granted a franchise for electric lighting in August, 1887 to furnish 40 electric lamps of 1,200 c. p., to burn all night. Either the Brush or Thomson-Houston system will be used. The contract price is $4,000 for one year.

New York City Bids.—The Gas Commission has rejected all the bids for electric lighting. New specifications will be prepared under the direction of the Corporation Counsel. The Mayor claims that the local companies have a combination to keep up prices.

The Marr Construction Company are installing a Westinghouse electric light plant (alternating system), consisting of three 750-light machines, at Annapolis, Md. They are also constructing the additional pole line for 50 municipal arc lights in the same city.

Anglo-American Brush.—In our last issue we mentioned that the Anglo-American Brush Electric Light Corporation were placing on the market £75,000 worth of 6 per cent. debentures; we are now informed that these have been over-applied for, and that letters of allotment and regret have been posted.—*Engineering.*

Electric Light Combination in Germany.—The formal announcement is made that the electric lighting firm of S. Schuckert, Nuremberg, Germany, has been consolidated with a number of its branches and subsidiary companies in Leipzig, Cologne, Breslau, Munich, under the new name of S. Schuckert & Co., Kommandit Gesellschaft.

Columbia, Tenn.—The Columbia Electric Light and Power Company are now constructing their Thomson-Houston plant, which will consist of a 50-arc light machine and a 600 light alternating incandescent machine. The engine and boiler are already set, and they hope to have the station running by July 1. Mr. E. Yoest is the secretary.

Farmington, Me.—The Edison United Manufacturing Company, of New York have filed a petition praying that the Farmington Electric Light and Power Company of Maine be decreed insolvent. A preliminary hearing has been set for July 3. The liabilities of the latter are about $4,000. The assets, consisting of the electric light plant. are estimated at $8,000.

The Electric Light on the Ohio River.—The Louisville and Hendersonville mail line of steamers have installed on each of their boats an Edison plant of fifty 16 c. p. lamps for lighting the dining room, engine room, etc., and a focusing arc light in a powerful reflector, placed in front of and operated from the pilot house, enabling the captains to make their landings as well by night as by day.

West Virginia.—Contracts for Westinghouse alternating electric light plant have just been awarded by the Blue Stone Electric Light Company, of West Virginia, to the Baltimore office of the Marr Construction Company, L. L. Kingsbury, manager. It comprises four towns, viz., Pocahontas, Bramwell, Mill Creek and Freemans. The pole line will be carried over the mountains in order to reach these towns.

Damages for Death by Shock.—The jury in the New York Supreme Court, before Judge O'Brien, brought in a verdict on June 14 for $2,000 for Mrs. Amalia Steiffler, who sued the United States Illuminating Company for damages on account of the death of her her son, Meyer. The boy on April 18, 1888, touched a dead wire which crossed a United States Illuminating wire in front of 7 East Broadway, and was killed by the shock.

APPLICATIONS OF POWER.

Jeanerette, La.—An electric road is proposed between Abbeville and Jeanerette.

Birmingham, Ala.—Mr. W. B. Copeland has formed a company which will build a Sprague electric road.

Birmingham, Ala.—The Birmingham Union Railway Company propose to operate their lines by electricity.

Nashville, Tenn.—The Suburban Electric Railway Company has been incorporated by W. M. Fleming and others, with a capital stock of $2,000,000, to build a local road.

Pleasant for the Shopper.—Kaufman, Straus & Co., a large retail concern in Louisville, Ky., advertise that they have made the hottest day cool and pleasant for the shopper by putting in electric motors to drive ventilating fans.

Boston, Mass.—The Boston West End Railway Company has declared a 5 per cent. semi-annual dividend on its common stock, payable July 1. It is stated that the proceeds of the sale of 1,000,000 feet of the West End Land Company's land, which is expected to realize $1,000,000, will go to equip the road with electric power. The Land Company now owns 3,800,000 feet.

PERSONALS.

Mr. Charles L. Buckingham will have an article in the July *Scribner* on "The Telegraph of To-Day." It will be freely illustrated.

Mr. Arthur L. Thomas, who has been appointed Governor of the Territory of Utah, is only thirty-four years old, and was a messenger boy in the Western Union office at Pittsburgh in 1869.

Mr. F. H. Whipple, of Detroit, has been appointed General Manager of the proposed electrical exhibition at St. Louis this fall, and he intends, he says, to give the people a display that will surprise them.

Mr. A. A. Knudson, the energetic superintendent of the electrical exhibition to be held at St. John, N. B., was in New York last week making further arrangements. The exhibition promises to be a great success.

Mr. Ludwig Gutmann, of the Fort Wayne Jenney Company, is at present in New York engaged on work at the large new plant of the Manhattan Company. It is not unlikely, he says, that he may again take up the cudgels of controversy with Mr. Harold P. Brown.

Mr. E. C. Rimington, a well-known English electrical engineer and writer on electrical subjects, is on a visit to this country for the benefit of his health and to make a study of American methods. His papers on measuring self-induction will be familiar to many of our readers.

Don Luis Mazzantini, who has been sent to the Paris Exposition by the Spanish Government as the best exemplar of bull-fighting and bull fighters, was at one time an officer in the government telegraph service. Instead of making "bulls," he now kills them with lightning dispatch.

Mr Leo Daft will read a paper before the American Institute of Electrical Engineers on June 25, at 8 P. M., at the College of the City of New York, Lexington avenue and 23d street, entitled: "Some Recent Work on the New York Elevated Railroads, and Its Bearing on the Rapid Transit problem." The paper will be quite elaborate and will in its special and general public bearings be one of the most important ever laid before the Institute. It was to have been read this week, but was delayed by the amount of work required in the preparation of some of the data, for which numerous special tests and experiments have been made.

MISCELLANEOUS NOTES.

The Callender Factory, at East Newark, N. Y., was struck by lightning last week and badly damaged by fire to the extent of several thousand dollars loss on the building, etc.

The Improved Edison-Sims Torpedo, which is operated by a motor connected with a dynamo on shore, has been given another successful trial this week. It is 31 feet long, weighs 3,000 pounds, and travels at the rate of 21 miles an hour.

"Electric Sugar" Frauds.—The trial of the electric sugar refinery case is bringing out some very interesting evidence as to the purchase by Friend and his confederates of the best refined sugar, and as to pounding it up for use as the pretended product of the Friend process.

Welding Barrel Hoops.—Electrical welding has given quite an impetus to many industries. At Worcester, Mass., the makers of a new hoop are using the process and find the saving over the ordinary mode immense, as a hoop can now be welded in two seconds. The hoop itself is of a corrugated steel, for use on flour barrels and four steel hoops now take the place of 10 wooden ones.

A Severe Thunderstorm visited the Eastern States on June 15. In New York a church was struck. At Newark, N. J., two churches were struck as well as other buildings. In Jersey City, 400,000 gallons of oil were exploded. At Plainfield, several buildings were visited, and the telephone exchange was burned out. At Frederick, Md., great damage was done, and telephone service was interrupted. There were several visitations throughout Connecticut, and at Hartford telephone, telegraph and electric light wires suffered. At Concord, N. H., occurred the severest storm seen there in half a century. At Pittsfield, Mass., over 100 telephones were burned out.

Temperature Regulation.—The Consolidated Temperature Controlling Company, of Minneapolis, Minn., have issued an important notice in which they call attention to the fact that they have sustained their patents in the courts, and that as one of the consequences the Guion Automatic Heat Regulating Company has made a settlement, transferred to the Consolidated Company all its patents and contracts, and retired from the business. The Consolidated Company will continue the Guion agencies as well as its own, and having improved and combined the Bradford, Guion, Butz and Sternberg regulators, offers apparatus embodying the best features of all, being automatic, simple, durable and practically perfect.

New York Electric Club Meeting.—The regular monthly meeting of the Electric Club will be held at the club-house on Thursday evening, June 20. The speaker of the evening, Prof. Robert Spice, will deliver a lecture entitled "Exact Ways of Determining Pitch." The lecture will be fully illustrated by novel and interesting experiments. Those members who had the pleasure of attending the last lecture given before the club by Professor Spice on "The Properties of Color," will remember with much pleasure the brilliancy of his experiments and the altogether enjoyable evening which the entertainment afforded. As the lecture will close the course of lectures before the club for this season, it is anticipated that a large gathering will be present.

Dentistry in Louisville, Ky.—Dr. Canine, the well-known dentist of Louisville has, perhaps, the most complete laboratory of its kind in this country, if not in the world. It contains a 25 h. p. boiler, 3 small engines and 5 dynamos of different shapes and sizes, which furnish light for his spacious reception-room, and three operating rooms. In each of the operating rooms, placed on a "conformable" bracket, rests a small electric motor, which was designed by the doctor to take the place of the ordinary dentist's lathe, and at the same time occupies much less room. A small switch operated by the foot cuts the motor in and out of circuit with the dynamo at will. The doctor says he can do much better work with his motor, and a great deal quicker, than with the ordinary lathe, as it enables him to move around the patient, which he could not do if he had to work the old-fashioned treadle.

BUSINESS NOTICES.

Chas. A. Schieren & Co., New York, are the patentees and sole manufacturers of the perforated electric leather belting. The perforations obviate air cushions; hence belts run slack with less strain on bearings, and without slip.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

Wm. Baragwanath & Son, of Chicago, have just issued a very neat and effective pamphlet relating to their steam jacket feed-water boiler and purifier, and additional interest is given to it by the portrait of the late founder of the house. The pamphlet contains not only illustrations and descriptions of apparatus, but many useful hints for the benefit of steam users. The list of prominent customers includes a large number of electric light companies.

The United Rubber Company.—This company, of Trenton N. J., has recently placed upon the market a rubber mat to be used under type-writers, one of which has been kindly sent to us. It certainly deadens the noise and produces an easier and more agreeable touch. It is also claimed that it will save wear and tear on the machine. These mats are manufactured in sizes differing according to the style of type-writer used, and are worthy the attention of all who employ these useful machines.

Buckeye Engines for Electric Lighting.—Among the orders received by the Buckeye Engine Company, of Salem, O., during the month of May 1889, were the following for electric lighting and kindred purposes: Messrs. Adler & Sullivan, architects, Chicago, Ill., one 8 inch by 15 inch, and one 10 inch by 18 inch; Western Electric Company, for Ashland Iron & Steel Company, Ashland, Wis., one 5½ inch by 10 inch; Mackintosh, Hemphill & Co., Pittsburgh, Pa., one 14 inch by 16 inch; Federal Street and Pleasant Valley Passenger Railway, Allegheny, Pa., two 24 inch by 33 inch; Central Thomson-Houston Company, for Brady's Opera House, Toledo, O., one 11 inch by 16 inch; Jersey City Electric Light Company, one 22 inch by 33 inch; Jenney Electric Company, for Sedalia, Mo., two 14 inch by 16 inch; Waco Gas Company, Waco, Texas, one 12 inch by 16. This is a fair sample of business the year around, in electric lighting engines alone, while other branches of industry are equally well represented on the company's order-book. The works are running full time, and prospects are quite encouraging.

Owing to the pressure on our columns, the Patent Record has been omitted this week.